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ABSTRACT

This publication is the last in a series of 12 giving the recommendations that were made for a broad and balanced education program in science for young people. This guide shows that learning to teach better science starts formally with initial training, continues through an induction period, and is consolidated through a regular in-service program. This guide also enables teachers to operate successfully in the system. Included are an introduction on what this guide is about, three appendices covering typical tasks, timetables, planning and preparation, additional readings, references and seven sections. Section one considers important trends and expectations. Section two considers needs, obligations, tutor's viewpoints, probation, and induction. Section three deals with plans for action, change, issues, and treatments. Section four discusses support agencies and money. Section five deals with curriculum guides, responses to and evaluation of the Secondary Science Curriculum Review (SSCR), inservice programs, and publications related to curriculum areas. Section six discusses workshops while final thoughts are provided in section seven. (RT)

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SECONDARY SCIENCE CURRICULUM REVIEW

SSCR

BETTER SCIENCE: Learning how to teach it

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Curriculum Guides

SECONDARY SCIENCE CURRICULUM REVIEW

SSCR

BETTER SCIENCE: Learning how to teach it

Curriculum Guide 12

Compiled by Joseph Hornsby

Heinemann Educational Books/Association for Science Education
for the School Curriculum Development Committee

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Foreword

This is the twelfth in a collection of twelve Curriculum Guides from the Secondary Science Curriculum Review, published jointly by Heinemann Educational Books and the Association for Science Education.

A Directory of Resources and a book, *Better Science: Making it happen*, which tries to set the Review's recommendations in the context of the whole school, will appear at the same time as the Guides. These will, when taken with earlier and forthcoming SSCR publications, including those from local groups, constitute the recommendations which the Review is making towards a broad and balanced science education for all the young people in our schools. The series title 'Better Science' is thus both apposite and self-explanatory. It is hoped that the next phase of the Review (1986–89) will achieve successful implementation of the recommendations.

But what is the status of these new publications apart from reflecting the formal approval and support of our major sponsors, the School Curriculum Development Committee and the Association for Science Education? From what sources have the recommendations within them emanated? Those readers unfamiliar with the history of the SSCR will find it explained within the Guides; but most will be aware that it set out as a project which tried fully to involve the practising teacher in the development of solutions to the problem of science for all. Thus, although the Guides have been compiled principally by the Central Team of the Review, they draw on the work of thousands of teachers in working groups over the past four years. Although the work of many of the groups is referred to in the Guides, it is not possible to refer to it all. In the *Directory of Resources* readers will find details of what many of these groups have produced. The writing of these Guides, however, would not have been possible without the groups' existence and the Review Central Team hopes that the content of the guides truly reflects their work. Thus the pronoun 'we', used within them, often reflects the view, gleaned over five years of consultation, of the practising teachers involved with the Review. On other occasions it can represent the views of the SSCR as constituted by the Central Team and Steering Committee and it is hoped that particular usage will be apparent from the context.

Jeff Kirkham
Mick Michell
Jeff Thompson
Dick West
(SSCR Curriculum Guide Editors)

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Introduction

What is this Curriculum Guide about?

For those of us who have complained about the high rate of change in education, the next few years are unlikely to give much respite. However, on a more optimistic note, we hope that hard-pressed teachers will find this offering a useful resource. **Better Science: Learning how to teach it** is concerned with the recommendations of the Secondary Science Curriculum Review for the professional development of science teachers, mainly through initial training and in-service education. The guide has been written specifically for teachers and is intended to help them in the following ways:

- advice is offered on the preparation of a departmental science curriculum policy which includes recommendations for personal and professional development through in-service education;
- questions are asked about the existing science curriculum, which are matters for consideration both by individuals and school science departments. The outcome of this exercise is the identification of in-service needs;
- the content and relevance to professional development of the other SSCR guides in this series are described (together with other useful publications);
- some of the recent changes in government policy related to in-service education and training (INSET) are mapped out; schools (in consultation with their local education authority, where appropriate) will be required to identify their INSET needs;
- pointers are given to current (1986–87) and possible future (post-1987) sources of funding which teachers, as individuals or as a department might need to use;
- various types of support (other than funding) which teachers might want to use are identified;
- advice is offered to those teachers representing their school or authority on local committees brought together to support initial teacher training programmes;
- the relationship between PGCE and BEd tutors, students, and the teachers in the practice schools is discussed.

In other words, the purpose of this booklet is to enhance the contributions made by initial and in-service education and training to improving the quality of science education offered to all the young people within our schools.

During Phase 2 of the Review, the members of the Central Team have been privileged to meet and converse with many people who were committed to improving the quality of science education in our secondary schools. This curriculum guide represents a distillation of ideas developed in those conversations both within and without the Central Team. In **Learning how to teach it** the compiler uses the pronouns 'we' and 'our'. They commonly refer to the whole Review, i.e. working group members (including their conveners and co-ordinators), the Central Team and a host of other people who have given freely of their time and advice. In other circumstances 'we' and 'our' refers only to the Central Team. The compiler intends that the context will be clear from the text and the use of these words will not lead to any misunderstanding.

SECTION ONE

Setting the scene

The last decade has been unique in many ways in the world of science education; ideas have been promoted and discussed, consultation has abounded and all this (with publication of policies) has far exceeded what has gone before. Few teachers can be familiar with all the current developments and we shall not attempt to identify every innovation that has appeared. This section will give you the flavour of the more important trends and expectations that could well involve you in one way or another.

The changing nature of science education

A strong consensus has emerged that science should be a core subject for all pupils of compulsory school age; and for a broader, more balanced and more relevant science curriculum. This runs counter to much current practice in schools, although the picture is changing. Previous attempts to encourage change in the secondary school curriculum have not always been as successful as was hoped. The Secondary Science Curriculum Review (SSCR) was set up as a result of the widespread debate and consultation referred to above, and its findings are a tangible expression of the consensus reached. It was based on a set of principles (listed in Box 1) and its initial work was to prepare a range of aims for science education. These, in turn, formed a framework to support much of the subsequent development work. The aims are to be found in the Review's consultative document (**1.1**).

If the Review is to support the implementation of its policies and findings during Phase 3 to the extent that they become an integral part of the science curriculum, then a major programme of In-Service Education and Training (INSET) is essential. This view has been expressed already by many bodies in their responses to the consultative document (see Section 5).

The Review should not be seen in isolation from other initiatives. Much of the work developed during Phase 2 is consistent with and supported by:

- *Science 5–16: A statement of policy* (DES, 1985; **1.2**). This is the first such policy statement from the Department of Education and Science where the principles on which science education for this age group should be planned are set out. The Department's expectations of the Review are expressed.
- *Education through science.* The Association for Science Education's policy (**1.3**).
- *The General Certificate of Secondary Education. National criteria for science* (**1.4**).

> The science education of all young people in the 11—16 age range should be:
>
> - justified in terms of their general educational needs;
> - a foundation for further, higher and/or continuing adult education;
> - balanced in relation to the first two requirements;
> - in accord with good practice;
> - developed from the 'bottom up';
> - meeting the need of girls, of disadvantaged students and those belonging to minority groups;
> - parsimonious in its approach to content and flexible in its teaching strategies;
> - developed to incorporate evaluation and assessment.
>
> In short, it should enable young people to gain knowledge, understand process, use their knowledge and place it in a social and cultural context and continue their education to higher level, if they so wish.

***Box 1** Science education for all: some SSCR principles*

From the beginning of the development phase (1983) the Review adopted a model of curriculum development which we have called a 'periphery to centre to periphery' model. This was an interactive model that identified expertise as being with practising teachers, in schools. With support from their local authorities they were encouraged to identify current problems and seek appropriate solutions usually through the agency of a local working group. The outcomes were passed through the regional network to other groups working in similar curriculum areas. Likewise, initiatives taken and support provided by the Central Team of the Review passed rapidly to local group members. Despite much of the development phase coinciding with unprecedented industrial action by many teachers and at a period when morale was at a very low level, the Review engaged a large number of practising teachers in the development work and dissemination process. Most importantly, it seemed that participation in a working group itself initiated a process of change in individuals

which reflected their already strong commitment to the personal and professional development fostered by the Review. (For a consideration of the process of change see **1.5**.) The Review is conscious that the management of change will require considerable support at the levels of individual student, teacher, department, school (headteacher and management team) and LEA. Clearly, support to teachers is best provided through a well founded and resourced system of in-service teacher education, which sees INSET as an integral part of continuing personal and professional development.

The Review, then, is a vehicle for change in the science curriculum; this has important implications at all levels for the educational world.

The changing nature of initial training

Following the publication of a joint circular (with the Welsh Office) called *Initial teacher training: Approval of courses* (**1.6**) (commonly known as Circular 3/84) the Department of Education and Science established the Council for the Accreditation of Teacher Education (CATE) to:

> *advise the Secretaries of State for Education and Science and for Wales on the approval of initial teacher training courses in England and Wales.*

This council, which was convened in September 1984, has a role in the accreditation of teacher training courses. CATE makes recommendations to the Secretary of State as to approval of the course, basing its decisions on the criteria in the annex to Circular 3/84. Some of the criteria used by CATE in accrediting PGCE and BEd courses are summarised below in Box 2. The proposals not only set the parameters for the college, polytechnic or university-based courses but also stipulate the setting up and operation of local committees. The proposals place great emphasis on positive input by experienced teachers to the professional development of student teachers and the ways in which they should be involved in support for new teachers during their induction period.

There are four further publications which you might find useful in understanding some of the changes in this area.

1 The White Paper on *Teaching quality* (**1.7**), which amongst other things examines the relationship between initial training and the task of teaching. It also describes steps taken to restructure initial training.
2 *The quality controllers* (**1.8**), University of London Institute of Education, which is a critique of *Teaching quality*.
3 *The new teacher in school* (**1.9**). This attempts to:

> *assess how well newly trained teachers in general are equipped for the work they are assigned in their first posts.*

4 *Teaching in schools: The content of initial training;* an HMI discussion paper (**1.10**).

A summary of some of the criteria in Circular 3/84 on which CATE operates:

- Only courses that have the support of local formally constituted committees (which include experienced teachers) can be considered for approval.
- Experienced teachers ... share responsibility with the training institution for the planning, supervision and support of students' school experience ... and ... (should) be given an influential role in the assessment of students' practical performance. They should also be involved in the training of the students within the institutions.
- Students should experience a wide range of teaching and learning methods and be given ample opportunity to discuss and assess them.
- Experienced teachers should be involved at some stage in the selection process of suitable student teachers.
- Teacher trainers 'should have enjoyed recent success as teachers of the age range to which their training courses are directed, and should maintain regular and frequent experience of classroom teaching'.

***Box 2** The changing scene in initial teacher training*

Further details of the criteria can be found in Circular 3/84 itself and in a series of papers called CATE Notes (see Section 2 and ref. **1.11**) However, other targets have also been set. One example (Circular 3/84) is that PGCE courses will increase to a minimum of thirty six weeks (which include fifteen weeks spent in schools).

As we have already indicated, the criteria used by CATE cover both BEd and PGCE courses. This development has proved sensitive both in the institutions and among teachers. One example will suffice. In the criteria which relate to the courses, the DES is asking for more subject specialisation in the training of teachers for the early and middle years of schooling (say 3–8 and 7–12). It is being argued very strongly by the institutions that this will work against an increase in the production of teachers confident to teach science to primary age children. Students who choose science as a main subject must have the appropriate O and A levels. Very few such people come through the system, currently, to take up primary science teaching. The need, as seen by the institutions, is for all primary teachers to have

a broad-based science programme during their initial training. This means that an opportunity to follow an extended course should be open to those students without specialised knowledge. In addition, the DES require 'that all class teachers, without exception, should include at least some science in their teaching' (**1.2**, Para. 21d). There may well be no conflict here as the expectation is that primary student-teachers will study all areas of the curriculum with one in depth.

It will not have escaped the eagle-eyed that there are implications here for the satisfactory science education (in secondary schools) of future primary teachers themselves.

The need for in-service training

Before we examine the current major reform of the pattern of in-service education, it would be useful to consider why INSET has been subject to reappraisal; it is now seen in some quarters as a major answer to the many problems which beset schools. One writer (**1.2**) in this field has claimed (**1.12**) that governments have given increased attention to INSET because:

- *they believe that educational practice needs to be more closely linked to national needs and/or the needs of the local community;*
- *approaches to educational change which neglect the INSET dimension are usually unsuccessful;*
- *teachers, like other adults, need continuing education to keep abreast of changes in modern society;*
- *there is growing concern in some countries about the quality of teaching and career development of those who have had less basic education and training than current recruits to teaching;*
- *demographic trends have reduced the demand for new teachers in some countries, cutting off one important source of new ideas, diminishing career prospects, and focusing attention on those teachers who are already in service;*
- *the general feeling that education has failed to fulfill the hopes of the expansionist era between 1964 and 1974 has created a public pressure for improved school performance.*

In putting forward our views on in-service education and training we are concerned to keep a balance between the two facets — education and training. (Some public statements have given the impression that all teachers need is re-training.) In the context of continuing professional and personal development of teachers it is beyond question that practitioners should have regular access to an appropriate in-service education programme. This entitlement should be given regardless of the external pressures which we identify in this publication. In addition, we see initial training, induction and in-service education as being inextricably interwoven, and the last is at least as essential to the continuing quality of the educational provision as the first two.

However, the individual teacher is likely to be less concerned in the first instance with the broad sweep of national INSET policies and contexts and more with how these may affect them personally, their students and their schools. Few would disagree strongly with notions such as:

- the initial training course and induction period can only at best be an introduction to the profession;
- the nature of current teaching responsibilities do change with time;
- responding to change itself alters the nature of the interaction between the task and the practitioner;
- advance preparation for future responsibilities, the development of early skills and the discovery and nurturing of new ideas is an integral part of continuing education;
- we need from time to time to stand back from the day to day turmoil of classroom life to gain a new and perhaps different perspective;
- if INSET is seen as just another pressure from outside then the process is an uphill struggle right from the start.

INSET then, has to meet many criteria, not only in terms of professional development but also in relation to career contexts and personal fulfilment. Teachers are responsible for the *education* of their clients. This surely means that INSET must be an 'on-going' activity. In addition, there is no question of restricting INSET to updating subject knowledge and 'tips for teachers', or to introducing and improving teaching skills and developing educational knowledge. Nor is it only about the introduction of and familiarisation with ideas currently being discussed and considered outside the routine of the school. It must also give due regard to the widening of cultural horizons and nurturing the individual and personal talent of many dedicated teachers.

One problem related to INSET is the long time-scale that is needed to see the effects of change brought about by the introduction of new ideas. Very often the pressures on teachers and administrators are such that they have to ignore developments that might well take a decade to bear fruit, so as to address the more immediate

crisis that demands a solution today. While much of what we consider later may appear to focus on the immediate or short-term problem, we are much more concerned with the long-term effects. In keeping with our view of how children learn we want to start where teachers are. As Michael Eraut (**1.12**) points out:

> *Even after a long period of technical training, developing one's own style takes time and one needs to ... learn, experiment, reflect, and create one's own interpretations.*

These expectations are obviously a major challenge to teachers, but for the moment, don't panic! This report will offer you, in later sections, much advice and direct assistance in meeting a range of difficult but nevertheless interesting tasks. Let us now consider in more detail how the world of in-service education is changing.

The changing nature of in-service education

Provision and policy

In terms of provision at national level, two major contributions to the in-service programme during the last decade have been the regional courses of the Department of Education and Science (DES) and the short courses of H.M. Inspectorate. In addition, teachers have been able to take part in long courses through the agency of the In-Service Training Pool. As local authority INSET priorities vary, the extent to which DES and HMI courses met the LEA demands has also varied although some patterns have emerged (**1.13**).

In-service provision and policy have changed rapidly during the last two years; and new types of funding have been added to a system that was already complex.

Now schools, and departments within schools, are being asked to identify needs and make bids for in-service money. So knowledge of the INSET scene will be essential, especially when the whole system of provision changes in April 1987. We hope that the following information will make the situation and the impending changes clear.

Provision up to April 1987

Apart from courses organised and run by higher education institutions and local education authorities from their own budgets there have been at least six sources of national funding for in-service support.

1 There has been a system of seconding teachers for long courses for fellowships, supported by an arrangement known as the **In-Service Training Pool**. Tasks in this area have usually been related to the improvement of professional qualifications or to developing some aspect of formal or informal local authority policy.

2 The **Education Support Grants** (ESG), have included support for developments in *primary science and technology* particularly for the appointment of advisory teachers. LEAs have had to make a bid to the DES for ESG funding and only some have been successful in obtaining a grant for that purpose. To date, no ESG money has normally been available for specific developments in secondary science.

3 The **In-Service Training Grant Scheme** has supported at primary level the training of *science co-ordinators* and, at the secondary level, the in-service education of *heads of science departments* (HOD). Programmes organised for science HODs are commonly known as 4/84, 3/85 and 1/86 courses, reflecting the numbers of the specific DES circulars which authorised them. Both of these moves are a strong attempt to make the DES *Science 5—16* policy a reality.

4 Many teachers have made use of a fourth area of support when attending **DES regional** or **HMI short courses.**

5 An important source of funding for in-service work also comes through grants linked to the Technical and Vocational Education Initiative (TVEI) which are given the name **TRIST** (TVEI Related In-Service Training) scheme. This money has underpinned a range of LEA-based initiatives.

6 Finally, during 1986, money was made available by the DES to support the training of secondary teachers for the implementation and operation of the General Certificate of Secondary Education (GCSE).

Provision after April 1987

The Secretaries of State for Education and Science and for Wales (1985/86) indicated in *Better schools* (**1.14**) that:

> *The Government ... agrees with the committee (the Advisory Committee on the Supply and Education of teachers, ACSET) that a radical change is needed in the funding and organisation of in-service training* (Para. 175);
> *The Government has concluded that the most effective way of achieving these aims would be through the introduction of a new specific grant to support LEA expenditure on most aspects of in-service training* ... (Para.176).

Provision will be available for:

- locally assessed needs and priorities;
- national priority areas identified by the Department of Education and Science (which includes science).

The central support will be available to the LEAs under a new **Training Grants Scheme** which will also cover groups other than teachers who work in the educational sector. The TRIST scheme will cease after 31 March 1987 as will arrangements for the In-service Training Pool.

Continuing reappraisal of national and local policies will be built into the new scheme. At the time of writing the formal guidelines for national policy have not been announced but a draft circular was published in June 1986 (**1.15**). We summarise some of the possible guidelines in Box 3.

1 The new scheme is designed to promote, support and encourage:
- professional development of teachers;
- more systematic and purposeful planning of INSET;
- more effective management of the teacher force;
- training in selected areas (national priority areas).

2 LEAs will receive an allocation for their locally assessed priorities and a separate allocation for each national priority area.

3 LEAs submit proposals for INSET based on indicated allocation for aided expenditure. These proposals to be indicated on a three year plan.

4 Secretary of State will allocate grant to support expenditure most likely to achieve aims in 1 above.

5 Training may include, but is not restricted to, training courses. It may also include, for example, secondment to industry and commerce.

6 All INSET activity should be properly monitored and evaluated and those returning from externally-based courses are to be encouraged to share their new insights with colleagues. LEAs will be expected to report the results of this process to the DES.

7 The LEAs are strongly advised on the need for close collaboration and co-ordination between authorities and between authorities and various agencies and users in the field of INSET.

***Box 3** 1987/88 framework for INSET in England and Wales*

National priority INSET for science

Authorities will be invited to use grant to support INSET for:

- **conversion and retraining;**
- updating re-entrants;
- newly appointed and/or untrained mature graduates;

and, in addition, for qualified teachers and advisory staff:

- science coordination in primary schools;
- heads of science on departmental management;
- science teachers teaching double subject science courses (GCSE).

How might this work out at school level? Each local authority is likely to have an INSET policy that will enable it to operate successfully within the national framework. How it will put this into practice within its schools will vary. However it is possible that:

1 Schools might be expected to have an agreed procedure for reviewing INSET needs and assessing priorities, including priorities for release.

2 A regular review of each school's INSET needs will be carried out and the outcomes submitted to the LEA, setting out the school's case for INSET provision.

3 The LEA will have to ensure that there are adequate staffing resources for each school to enable school-based INSET to take place.

We have summarised (and simplified) some of these relationships in Fig. 1.

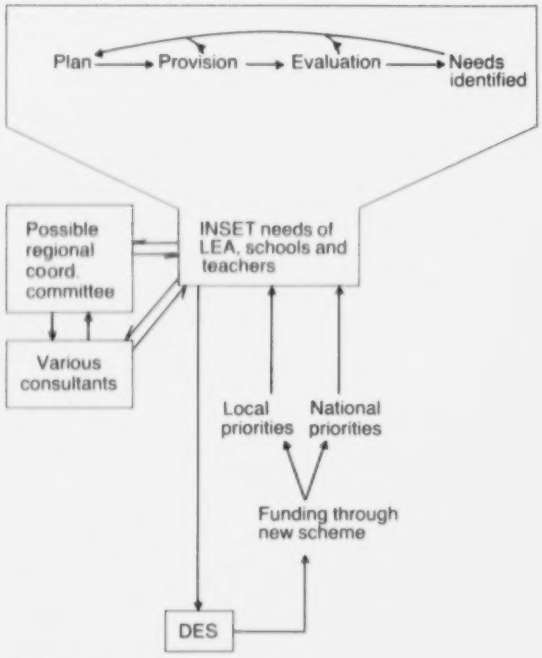


Fig.1 Provision of INSET

In addition to these policy developments the form, content and nature of in-service education have undergone change in recent years. During 1985 the Review tried to identify current INSET that was of interest to science teachers. All institutions of higher education in England, Wales and Northern Ireland were invited to contribute. Forty-four replied to the request for information. The main conclusions of the report (**1.13**) are outlined in Box 4.

1 Higher degrees, diplomas and full-time BEd courses are almost exclusively devised within the institution which assesses the candidates and awards the degree or diploma, there rarely being any contribution from outside agencies.

2 These courses are essentially the only long-term and full-time INSET provision offered (little information referred to fellowships).

3 Collaboration between institutions and other agencies such as LEAs, HMI, teachers' groups, etc., is greatest in the 4/84 (3/85) Heads of Science courses.

4 Subject update courses were often produced in direct response to specific demands from local teachers or LEAs.

5 The 4/84 courses undoubtedly gave major impetus to the development of management and organisational skills, for which there had been previously only a minor provision.

6 In-service courses appear to be fairly well evaluated. Evaluation of their effectiveness in bringing change into the school system is, however, rarely considered. In practice it is unusual for any course evaluation to continue once the teachers attending the course have been assessed. In terms of teacher assessment more recent courses are beginning to rely on the development of school-based case studies and course work rather than on formal examinations. 4/84 type courses have no formal assessment although teachers are set various tasks which are intended to be followed up in schools—see Appendix A. Some HE centres have 'firmed-up' these tasks into an award.

***Box 4** A summary of findings from* 'INSET for science teachers' (SSCR INSET Survey, 1985)

Prior to the development of the 4/84 and 3/85 courses, and the publication of materials such as the ASE/British Gas Management packs (**1.16**), INSET programmes for science teachers which focused on management training were rather thin on the ground. It is paradoxically true that such courses were available (for cross-disciplinary groups) but because they were not set in the context of science subjects they played only a minor role in the professional development of science teachers.

The experience of some INSET tutors suggests that much science in-service work in recent years has been subject-oriented and rather traditional. For science teachers willing to move out into cross-disciplinary groups there are wider opportunities for management training (H.Bradley, personal communication). In addition, little attention has been paid by many science teachers to the INSET potential (e.g. the sharing of knowledge and experience) of co-operative research based in the classroom or laboratory. Commonly called 'action research' it is suggested that those who participate in it can undergo a major form of professional development (**1.17**).

The 4/84 courses had curriculum change and management strategies as major areas of activity and hence the exercise (involving teachers, advisers and the institutions) was inherently collaborative both in design and teaching throughout the course. In addition, the task-centered aspects, the need to bring new insights and new methodologies into the classroom, again necessitated a co-ordinated input from a variety of sources other than the HE institution on its own.

In general, the focus of courses is shifting from the exclusive study of educational and management theory towards the study of classroom and school, with course providers placing a greater emphasis on enquiry and classroom research methods although, as we indicated above, the movement in science has probably been less than that in other curriculum areas. There is also a distinct move towards encouraging course members to address common problems together and hence gain a better insight through the pooling of experience and wisdom.

The mode of attendance at courses has shifted away from full-time secondments towards part-time, day release, week-end and summer school patterns. This has certain advantages as it allows a more flexible use of those few supply teachers who offer shortage subjects.

Finally, the assessment of in-service courses is also shifting from an over-reliance on formal examinations to the preparation of case study reports, observational reports and the use of various forms of enquiry studies and projects. (Some courses are not assessed.) The dominant style of provision is, therefore, changing from using a transmission mode of delivery to provide information about educational views and theories, to carrying out practical investigations which test out ideas in school or classroom conditions. Nevertheless the motivation for involvement in in-service education still remains largely **individualistic as distinct from**

institutional, and it is still often difficult for individuals who have undergone extensive further education and training to influence schools when they return to full-time teaching. The problem is addressed in this document but will be an integral part of the third phase of the Review. One of the remaining problems is that as long as teachers are expected to attend professional development courses during their own time, then those programmes that offer a career qualification (e.g., MA or MEd) and have little impact at school level, will appear more attractive to some teachers. This is recognised and the recent spate of 4/84, 3/85 and 1/86 courses have gone some way towards meeting the problem. It is likely that the change in INSET provision already referred to earlier will go much further towards a solution, although there will still be a lot of work to be done in teachers' own time.

In the primary sector, some science courses are linked to awards because they arose out of existing arrangements. For example, courses run for primary science co-ordinators at a variety of institutions may be continued by the students for a further two terms. This extra work together with a school-based assignment is submitted for the ASE's Diploma in Primary Science award. These courses are directly linked to the production of a school policy for science, and with the management of science throughout the school. A point for secondary education planners to note!

What do teachers want from INSET?

Every school or school science department that responded to *Science Education 11-16: proposals for action and consultation* (**1.1**) had something to say about INSET. Their concerns are listed in Box 5. The Review would claim that many of these concerns are met jointly by the DES INSET guidelines and this report.

It should not be assumed that all in-service work takes place through and as a result of courses. Many of the developments mentioned earlier, have enabled teachers to be released for part of their teaching week to work on tasks specific to their school's needs. In Section 3 we examine a range of in-service modes all of which, at different times could be part of an INSET programme.

We would, however, like to introduce a note of caution, not because we wish to pour cold water on the various (and we believe essential) proposals but because the way ahead is by no means clear nor without problems. For example, we must not assume that all teachers would choose to take part in in-service work, either in their own or school time. Perhaps few would do so; to encourage others to participate it is essential to create a positive and supportive atmosphere. It would be prudent to consider the impressions and effects teachers returning to school from in-service training may make, and to recognise, as we do, that not all INSET is good INSET. But these are not insuperable problems and our intention is to provide some of the solutions. We do stress throughout how much can be gained through consultation and interactive negotiation of INSET provision, allowing this to be specifically tailored to meet particular needs or problems.

1 In-service training should be in school hours with adequate lengths of time for the courses and adequate funding.

2 Priorities for the in-service structure should be worked out, prior to setting up courses, in consultation with teachers so that the courses would be of good quality. This was felt to be necessary to convince teachers that re-training was essential

3 Local involvement of polytechnics and universities should take place as a part of the structure of the courses, and the meeting of local needs should be seen to be an important part of the course.

4 In-service training must be treated as a major exercise for which generous funds should be forthcoming.

5 The reluctance of specialist teachers to consider teaching outside their academic specialism, the time needed to implement changes and the cost of the proposals were seen to be major problems.

Box 5 What do teachers want from INSET? (**1.18**)

A theme within a theme: an introduction

Teachers do look for practical advice; both in respect to classroom experience and organisational or management skills. In this guide we are going to repeatedly use the same two examples to illustrate our views about coping with change in science education. We see both examples as important areas of concern where there is strong pressure for change.

The first (which we will call **Example A**) involves **acquiring expertise in a subject area other than ones own**—part of the move towards 'broad, balanced and relevant science for all'. Such a move may result in a school deciding to broaden its science curriculum by the addition of some geology, biotechnology or electronics.

Perhaps it decides to move towards a scheme of co-ordinated science, or integrated science. Subject specialists will then be asked to teach in unfamiliar subject areas and will need to broaden their own expertise to cope with such developments. Our Example A tackles some of the issues that arise as a consequence of such a decision.

Example B is a little different in that it is a more general response to changes in science education. Much has been said of the need to make **special provision for girls in science.** The school or the individual teacher may want to approach this issue in a range of different ways, both within the department and within their own classroom. Our Example B attempts to illustrate ways in which INSET activities can be organised to meet these needs.

These two examples will be used to illustrate the application of principle to practice in *A theme within a theme* at the end of Sections 2 and 3 of this guide.

THERE'S A LOT OF WORK AHEAD
IT'S GOING TO BE A CHALLENGE
I'LL NEED SOME HELP
THIS SOUNDS REALLY INTERESTING
THERE'LL BE MORE JOB SATISFACTION

SECTION TWO

Starting to teach

Initial considerations

As we have indicated earlier (in Section 1: *The changing nature of initial training*) initial teacher education and training courses are currently undergoing close scrutiny and not a little change. We have outlined some of the criteria set out in Circular 3/84 (**1.6**) and have introduced the role of the Council for the Accreditation of Teacher Education (CATE). This section is concerned with developing some of the issues raised through briefly looking at a small number of new initiatives. Although we will be considering developments as they affect initial training courses we address our comments and questions primarily to experienced and practising teachers both to inform and to prepare the way for further involvement.

As a result of the responses to Circular 3/84 and the work of CATE in reviewing all existing approved teacher training courses between 1985 and 1988/89 it is likely that many experienced science teachers will be consulted about or involved in some way with these initiatives.

For those teachers invited to join the local committees (see Box 2) we suggest that you read Circular 3/84 and obtain the CATE Notes (1—4 at time of writing) from the institution inviting you. (Copies of the notes can also be obtained from the DES at Elizabeth House, York Rd, London SE1 7PH.) These cover:

CATE Note 1. The Council's approach to accreditation
CATE Note 2. Local committees
CATE Note 3. Subject studies
CATE Note 4. Links between initial teacher training institutions and schools.

As we indicated earlier a valuable and general source of advice comes from H.M. Inspectorate. This is in the form of *The new teacher in schools* a report by HMI (**1.9**).

For science teachers one very important development has been the setting up by the Association for Science Education (ASE) in 1985, of a working party under the auspices of the Education (Research) Committee. This is known as Science, Initial Training and Early School Experience, or SITES for short! Its report called *The making of a science teacher*, which is in preparation, is likely to become available during 1987. It will detail aspects of initial training, probation and induction well beyond the brief of this guide.

A number of local authorities have guidelines or policies to assist teachers in their work with student-teachers or probationers. One example is *Help for new Heads of Science* published jointly by Gloucestershire Education Authority and the ASE (**2.1**). Many other authorities have a well-defined induction programme for new teachers and we draw on some of their experience in a later section.

The general pattern of school experience for student-teachers is fairly familiar although it differs in detail from institution to institution. Other less well known initiatives are appearing. We outline three of them which reflect the level and type of present changes in teacher education, and which may well have wider currency in the future.

First we have Initial Training—In-service Education and Training (IT—INSET). This programme was first developed during the mid 1970s and has received funding from the DES. It has been utilised in a large number of training institutions and is currently co-ordinated by Dr Ashton, Director of the Centre for Evaluation and Development of Teacher Education (CEDTE). The intention is to provide initial and in-service training for the student-teacher, the student's tutor and the class teacher *at the same time.* Patricia Ashton (**2.2**) describes it very clearly.

> *As the name IT-INSET implies, the programme aims to provide joint initial and in-service training. It takes place in the classrooms of volunteer teachers who agree to analyse and evaluate some feature of the curriculum they provide in co-operation with a tutor and a group of students who join them regularly for the purpose. All team members — teacher, students and tutor — plan together how and what they will teach, teach co-operatively, jointly review what they have done and plan again...*
>
> *The IT-INSET programme is based on certain principles for teacher education. The first principle is that the entire training focus, initial and in-service, should be upon pupils and the quality of their curriculum experience. The centering of effort upon the quality and the effectiveness of children's learning is an imperative for schools. Such a focus, however, points up the understanding and the skills*

needed for effective teaching. Teaching skills, for example, are identified in terms of what is needed to enhance pupils' learning in the classroom, and this approach contrasts with one based on a hierachy of skills sequenced throughout a college or university course.

In order to achieve genuine curriculum development, the second principle upon which IT-INSET is based is that teachers, tutors and students must take an evaluative stance towards education.

The third principle for teacher education, underpinning IT-INSET, is that practice must come before theory, initially in a temporal and subsequently in a conceptual sense.

The fourth underpinning principle is that teacher education must occur through a collaborative learning process in which the varied experience and expertise of teachers, tutors and students is shared. If the goal of teacher education, initial and in-service, is continuously to enhance the curriculum experience of pupils, then a concept of teachers, students and tutors learning with and from one another is essential. No one party can accomplish the task alone.

The IT-INSET programme espouses the principle of collaborative learning, even in its title, by combining initial and in-service training where the in-service training applies equally to the tutor as to the teacher member of the team.

IT-INSET is therefore both based in school and focused on identified classroom issues.

The second development that we would like to highlight had its genesis in 1965 at the University of Sussex. In this model, initial training is school-based, with three days per week being spent in school and two days in the institution. Experienced teachers (who act as teacher-tutors) are paid by the university for weekly tutorials that they conduct, for the student-teachers, outside normal school hours. In addition, general tutors (who could be headteachers, deputy head-teachers or more likely senior teaching staff) are also paid by the university, and are responsible for holding regular seminars for all the student-teachers from different disciplines. The university tutor helps in an overview capacity through liaison between student and teacher-tutor, by providing a focus for the university seminar, feeding in ideas from outside the school, and keeping an overall view of standards.

The student is expected to keep school-term times rather than university-term times. They have an opportunity to observe their teacher-tutor within the school, and gradually will be phased into a team-teaching experience. Eventually, they assume responsibility for a cross section of classes. The student is also expected to play a full part in the life of the school outside the demands of subject teaching. (For fuller details see **2.3**.)

An innovation of the same kind has recently been the subject of co-operative research and involves Roehampton Institute, Leeds Polytechnic and Leicester University Department of Education (Northampton Annexe). Oxford University are also known to be developing their PGCE course in a similar but not identical way.

The third current development involves an even more radical change. One institution (Roehampton Institute of Higher Education) is currently planning to introduce a PGCE/INSET course which covers two years and combines initial training with induction and in-service education. The purpose is to provide high quality science teachers, capable of:

- teaching across the sciences to age 16;
- teaching a specialist science to age 18;
- giving curriculum leadership across the sciences;
- having an empathy for the place of technology in the science curriculum.

Successful course members will be awarded their Postgraduate Certificate after one year, and at this point if they are also acceptable to the local authorities concerned they will become full-time employees of an LEA. During the second year, half of their time will be spent teaching with the remainder being for in-service education. This will involve a college-based course designed to continue their development and also to help work within the school science department. Obviously very close co-operation between all the parties concerned will be essential. Many will be watching the progress of this innovation with considerable interest.

The needs of student-teachers

During their education degree course (BEd) or the postgraduate year (PGCE) students are undergoing an attitude change. They are no longer the prime customer of the education service but are reconstructing themselves first as student-teachers and then, eventually, as teachers. The needs they have and the experiences they share are in the end directed towards this transformation. Early in the course they should be challenged to consider teaching and learning from the different perspectives of student and teacher. This is not to suggest that any problems they had in learning as students should be ignored or forgotten. Indeed one mark of a skilful teacher is the ability to relate their own learning experiences to those of students and to

analyse the learning process from the perspective of the students. Above all, the preparation for teaching should be seen as a partnership between the aspiring teacher, the higher education institution and the schools. Obviously other bodies and individuals play an important role but this three-way partnership is at the heart of the metamorphosis that produces able and committed teachers. We will examine each of these elements in turn but always in the context of helping teachers better to understand, contribute to and use the systems.

The higher education input

Many colleges of higher education and university and polytechnic departments of education have prepared, in consultation with teachers, guidelines to be used for the benefit of student-teachers and schools. The support given (often in the form of a handbook) usually covers a wide spectrum of school-based issues that the student-teacher is likely to meet on teaching practice. To give you a flavour of the assistance offered to students we have printed two different extracts from PGCE handbooks. These are to be found as Appendix II and Appendix III, respectively. The first is a diary/timetable of the education year for students who offer chemistry as their main subject at Newcastle Polytechnic and has been kindly provided by Mike Byrne. The second is part of the advice given by Nottingham University Department of Education to its students on the matter of lesson planning and preparation. This is published by permission of Professor Philip Gammage. Much of the content of the handbooks is also valuable to the probationary teacher.

In addition to pragmatic advice, most institutions do offer a wide range of additional services to their students, for example, in areas such as counselling on careers.

The school input

As we have indicated earlier, it is our intention to help teachers to understand better the various roles they fill. In the case of the school contribution to the professional development of student-teachers we present a set of questions. These are directed to the senior teachers responsible for students, to help them improve their understanding of the student-teachers' needs. These are fairly obvious questions, but you might like to adapt them to provide a checklist more suited to the organisation of your own school. The framework is based on guidelines used by S. Martin's College, Lancaster, with their students and teaching practice schools. The questions are, of course, given out with boxes at the right hand side to be used for notes or comments.

1 *The general organisation of the school and department*
(This group of questions relate to information offered during pre-practice visits.)

Who has overall responsibility for student teachers?

Consider who is responsible for explaining to student-teachers about:

- the goals, aims and objectives of the school curriculum;
- the school timetable (length of periods and number of periods allocated to subjects);
- group organisation in the various years (e.g. mixed ability, grouping, banding, setting);
- the organisation of pastoral care and general day to day administration;
- the library or resource centre procedures;
- regulations about school dress;
- the authority structure in the school;
- the school's policy on discipline;
- how to deal with problem pupils;
- action to be taken by a student experiencing difficulties in this area;
- fire and safety procedures.

Are there planning/marking/quiet areas where the student-teachers can work when they are not teaching or observing? If not, what positive arrangements can you make?

Do you expect the student-teacher to attend any meetings? If so, has it been explained why these would be useful to them? Are you prepared to listen to or agree with reasons for not attending?

2 *Specific organisation in the department*
(This second group of questions can be considered either in the pre-practice visits or during the practice itself.)

Who is responsible for the departmental aspects of teaching practice?

What are the responsibilities of heads of subject and class teachers towards the student-teachers for:

- preparing the teaching practice timetable?
- ensuring, if possible, a wide spread of age and ability classes?
- lab or workshop practices and technical help?
- the textbooks, exercise books, files and other resource material used by the various classes taught by the student-teacher during the school practice?

- explaining and discussing scheme of work for each class likely to be taught?
- the materials and teaching aids, the copying facilities generally available for the taught subjects?
- the past experience and current attainment of classes taught, notes on individual pupils and class lists?
- a clear picture of the outcomes/aims/objectives expected?
- ideas for making the work relevant and making an impact at the beginning?

Are there opportunities to try out experiments and visual aids?

To help in the monitoring of the student-teachers' progress a lesson observation checklist for observing and identifying strengths and weaknesses is useful. A daily schedule of observations can be built up into profiles of students to help them develop more effectively into the forthcoming role of teacher.

Student-teachers are in a position of great insecurity — a point experienced teachers may have forgotten as the years pass — they are almost certainly specialists and may be surprised to learn that not everyone is fascinated by the chemistry of salts or that a child's language is not the same as a scientist's (beakers may be jars, scalpels knives, etc.) Latecomers to lessons, lost books and pens will almost certainly disrupt the pre-planned pattern and considerable gentle guidance will invariably be appreciated especially if criticism comes with praise.

A simple schedule for analysis/evaluation of lessons is given below, this is again based on the S. Martin's College guidelines. Other examples are discussed in *The making of a science teacher* (**2.4**). These can range from the general to the very specific.

3 *Analysis and evaluation*
(This group of questions is related to the analysis of the student's teaching and while they should be discussed prior to the practice the actual assessments take place during the teaching.)

(a) Student-teacher performance:

- suitability of lesson's objectives — were they achieved?
- lesson introduction — did it stimulate interest?
- demonstration techniques?
- use and organisation of materials and resources?
- use of blackboard or OHP?
- class discussion and questioning:
  instructions to pupils
  supervision of pupils' work
  varied use of voice?
- behavioural problems?
- flexibility/modification within the lesson?
- lesson conclusion?
- teacher input time/pupil input time?
- teaching approaches?
- marking/recording?
- relationship with the teachers and technicians?

(b) The pupils:

- involvement or 'boredom'?
- contributions by all individuals?
- difficulties in understanding instructions?
- difficulties in understanding work?
- learning outcomes and opportunities?
- teacher/pupil relationships?

4 *The end of teaching practice*
(Although billed as 'end of practice' the following questions should also be considered during the main practice itself, especially where the need for compensatory action demands a rapid response.)

At the end of the practice are there opportunities, formally and informally to:

- identify any compensatory action required through self analysis and discussion with teachers and tutors?
- try again, review and improve?
- reflect, discuss with colleagues and tutors, to gain confidence and grow?

Obligations on schools

Teacher demands and pressures on students

Picture the following scenario! It is the end of summer term, a time to reflect, plan and organise for next year and dream of a few weeks in the sun!

A notice from the local higher education edifice appears on the staff notice board. HODs are to fill in requests/non-requests for teaching practice students next year. Prospects of getting a good student, reduced workload in classroom, re-charging batteries, etc., appear rosy.

Weeks pass, November's dark days approach and so does student and school play and mock exams and half-term grades and reports and parents' evenings. Head passes student to HOD; student is 'given' to various subject teachers as day progresses.

Have the class teachers been told:

- anything about the student's background?
- what the college expects to do or the students to do?
- how much help to give, what teaching load to suggest?
- what the student expects them to do?
- about the college teaching practice arrangements, requirements and expectations?
- what they can do to help the specialist graduate become a science teacher before next term?

Have they free time available to sit down and talk through the practice period?

Can they have confidence in the biology graduate handling 2nd year topics in physical science or the physics graduate teaching remedial third years to grow bulbs or sex guinea pigs?

Before the carol service/parties and mince pies the student has had two days in school and hopefully has gathered enough information together to meet the expectations given as advice in their PGCE or BEd handbook.

January dawns. The New Year parties finish, ASE Annual Meeting, term and teaching practice students all appear. Nervous student watches for a day or two. Then the big jump.

The first class lesson. Will the student cope with the extra pressure of remembering:

- what to say, how and when to say it?
- to keep class interested, happy, busy and disciplined?
- to give out and take back in *all* apparatus, to set homework, to get in marks, to monitor pupils problems?
- to check by quick glances reaction of class teacher, 'marking' in corner or peeping through prep room door, and hope for constructive advice, much needed support and encouragement?
- to be always organised in case of surprise visit by Head, or by tutor — who not only helps but also is *the* assessor?
- that there are only eight lessons in a day and five days in a week, there will be time to prepare for tomorrow, sleep, look for jobs see friends, eat, recover?
- that teaching can be fun and rewarding?

Student keeps going. Teacher watches, gets involved, wants to help, wants to leave student in lab alone, etc.

How well defined is the class teacher's role?

- Can s/he legally leave the student alone; what is college, school, local authority policy?
- Can the teacher influence the assessment not just by odd chats with tutor but in a formal report/discussion?
- Is there a teacher/supervisor in the school or group of schools to organise the practice and monitor progress?
- Has the teacher a long-term involvement with the HE college so that s/he is or can become involved and develop a knowledge of ITT and school practice?

Towards term end some problems will have been resolved, some not. The tutor appears in the staff room a few times, brief chats over coffee take place between staff announcements, children at door and phone calls. The practice ends. Students say goodbye and thanks, there is relief and smiles all round. The teacher picks up the class again for better or for worse – depends on the quality of the student.

There's no time to appraise one's own effectiveness as teacher trainer, discuss with tutors, review with HOD or Head or move to improve one's performance as teacher trainer next year; so back to coping, surviving and crisis management.

But it's summer again – external exam time; school exams to set and mark; end of year reports; departmental stock checks and tidyings; staff cricket, tennis and the summer break. A notice appears in the staff room...!

In this scenario there are implicit criticisms of a situation that is less than satisfactory. Despite the good intentions of all concerned, what we have described is an operation by default, a stumbling from one minor crisis to another. Can anything be done?

It would be naive to think that there is a simple, single answer. This is a challenge to the management and organisation team and to the subject or department head. Above all, it focuses attention on the role of the school and its relationship with the institution of HE and on their combined and co-operative venture on behalf of the student-teacher. In many secondary schools there could well be four different individuals or groups who have some responsibility towards student-teachers.

First, there is the senior member, possibly a deputy head, who is responsible for the general welfare of students on teaching practice. In some schools this role may be taken on by the teacher-tutor whose responsibilities in the induction

programme we outline later. A large school could have a number of experienced teachers working with the HE institution as members of the local committee which we described earlier. Finally, and most importantly, there is the class teacher who might well spend more time with and on behalf of the student-teacher than anyone else.

Collectively, those with responsibilities for student-teachers in school need to define the partnership between the school, the individuals concerned and the prospective teacher. They are likely to realise that the busy class teacher (who often does a lot of work for the student, but rarely gets the recognition) is a vital link with the student. Perhaps the role of the class teacher requires more formal recognition within the management structure of teaching practice organisation; the partnership must be encouraged to develop and the teacher given the time and opportunity to play a full part. This, of course, is not just with respect to the final assessment of the student-teacher.

One problem facing all who are involved in teaching practice is time: time to meet, discuss and agree policy with colleagues; time to work and talk with the student-teacher about all the processes necessary to set them on the right path and time to meet the HE tutor to discuss, in depth, the work of the student. The recognition that there is a problem, that this area of professional responsibility needs careful monitoring, is in itself a step in the right direction. We hope that our contribution in this guide will be of some assistance in enabling a more supportive climate to emerge.

The higher education tutor's viewpoint

It is the student's needs which are paramount. They are the focus of the relationship between the school and the training institution of higher education, as they are, too, between tutor and student. To be effective the HE tutor really should have a continuing relationship with the school and its staff so that mutual trust, understanding and respect can be fostered. The school must provide a supportive environment both for the student-teachers, if they are to give of their best, and for the tutor too.

The tutor's close relationship with the school is necessary so that the tutor is familiar with:

- the details of the school's timetable, holidays, working procedures and special requirements;
- the school, its hierarchical structure, teacher contacts, meeting points and procedures when visiting becomes established;
- the discipline procedures, pastoral and subject divisions and various allocations of responsibilities within the school;
- the science department's procedures and especially the fulfilment of safety requirements and the use and availability of technical support.

The tutor will also be anxious to ensure that in turn all staff working with students have detailed knowledge of:

- the roles of subject/practice tutors and of external examiners;
- the specific timetable of the teaching practice and the way in which school experience and teaching practice are structured (including the balance between observation and practice);
- the incoming students' teaching practice demands and each individual teacher's responsibilities for the students.

Furthermore, the tutor might well hope to work in the school over a period of time, with groups and with individual students. A continuing relationship with school staff would clarify staff perceptions of their own and the tutor's role when working with students in schools; ideally all class teachers should feel personally involved in the day to day supervision of the students, and of their professional development. This would not only make the tutor's role easier but would enhance its effectiveness and, it is hoped, the quality of the student-teacher's work in schools too. All this is dependent on the professional relationship between the tutor and the teacher, at the personal level.

In the future, as the pattern of INSET provision changes and the school experience requirements of HE tutors vary, a richer and more fluid exchange of tutor/teacher roles can be envisaged.

The HE tutor's function in schools might expand into blocks of full-time class teaching experience; into the running of INSET workshops to promote the school-teachers' professional development, and into helping staff develop their training role both in terms of subject expertise and of teaching skills and methodologies. Experienced staff might similarly play a part in the induction and probationary year's programme for new entrants to the profession. They could initiate new development work and be a source of information/expertise in curriculum changes and innovations through school-based INSET time. Additionally, the tutors themselves could gain new insights and an increased depth of practical experience by formally structuring a system allowing teachers to share their expertise with the trainers and the college-based students.

The class teacher and the tutor manifestly have complementary roles in the professional

development of student-teachers. The expertise of the teacher differs from that of the tutor. The tutors should have a sharper understanding of the students' problems than the class teacher; the teachers, on the other hand, have a range of teaching and organisational skills which the tutor could well envy. It should not be the 'luck of the draw' when these assets come together for the benefit of the student-teacher. Does the climate of your school foster such close reciprocal professional relationships?

Some thoughts

1 If teachers had more practice in evaluating their own work and teaching skills, would they be more able to help the students and would there be more discussion in staff rooms of the actual methodologies of the teaching process?

2 Initial teacher training (ITT) is occasionally pictured as a tripartite co-operative process, involving students, HE tutor and teacher. Indeed we referred to it in this way earlier in this section. However, in practice, the relationship is more complicated and also involves teacher-tutors and advisers, as well as others in the school who are likely to take a professional interest in the student's welfare. The needs, expectations and roles of each of those also require consideration.

3 It is unlikely under present conditions that all schools can expect to accept student-teachers for school practice as a right. Bearing in mind the DES 3/84 requirements and the expectations of CATE, how can you ensure that you are informed (and consulted) of developments and changes in practice?

4 If you already are, or expect to be, a participant in a teaching practice scheme, then have you considered to what extent:
- you should actively work with the colleges to time-table student-teachers into the school's working year?
- experienced teachers and HE tutors should share roles and work jointly to enhance the quality of the students' induction into the classroom?
- not only Heads and HODs but all teachers working with students in schools should have a definite framework in which to work and a definite understanding of how they can best help the student to become a better teacher?
- all teachers the students meet should feel committed to helping prepare them for the full-time classroom teaching load?

If your answers to these questions is 'yes', what steps need to be taken to realise your intentions?

It is, of course, easy to ask questions, we do so because these questions are being asked (and answered) in the system now. Thinking about the possible answers to them should help you to form your own judgements and give you some insight into the roles and expectations of others with whom you will be working.

Probation

There is an obvious tension between the function of induction and the purpose of probation. The senior teacher responsible for the induction programme (certainly at subject level) may well be the person who also has the task of assessing the competence of the probationer. The extent to which one responsibility is partly an evaluation of the effectiveness of the other is not always appreciated. We would like to explore this briefly using an account of one probationer's experience. Although the following diary entries are fictitious and have been written to highlight certain issues related to the problems faced by a new teacher, they have been culled from an account given by a real probationer to her LEA science adviser. The incidents occurred over a period of two terms but for the purposes of the narrative have been condensed into one fictional week.

A week in the life of a probationary teacher

Monday

I request that the HOD and subject head observe my lessons on Tuesday and Wednesday. Request agreed to.

Discuss departmental worksheets with HOD. They are very prescriptive leaving little opportunity for me to develop my own teaching strategies. The sheets were prepared by senior colleagues and have been re-drafted after initial use. I'm told that everything the kids need is there so I'm not to worry.

Tuesday

Request help with one fifth year class who are (for me) almost unmanageable. Help promised.

Request an advanced copy of worksheet I ordered last Friday for use with third year this Friday. It is not ready.

Male colleague takes apparatus made up for my use with third year. My order was in on time and technician tells me that colleague did not order it at all. Suggests I see HOD. HOD says exam class should have priority. I have to re-plan lesson.

Wednesday

Fed up! Nobody came to see my two lessons despite promises. HOD tells me he's sorry but he had to cover for French dept. Cry on Jane's shoulder.

Departmental meeting after school. The main item on the agenda was about the special needs course. I have a lot of ideas to offer having made a special study of this at college but I'm told they are too idealistic and they are not discussed at all. One student appears to be causing trouble throughout the school. Despite teaching him, my views are not sought. When I volunteer them and suggest that he's not as bad as he's painted I'm told that I'm too soft. I feel very isolated.

We discuss next year's timetable. It looks as though I'm going to have more than my fair share of remedial and difficult classes. All the exam classes are being allocated to senior people. 'We can't risk them you know. Wait until you have some more experience'. Jane's been teaching four years and she just had her first exam class this year.

In AOB I raise the question of formative assessment. Have my leg pulled about using jargon. The matter is not pursued because too few think that it is a problem. I have no real understanding of the standards that the dept. expects. These men are so CONFIDENT that they are RIGHT! Jane tells me that when she challenges them on some educational matter a lot of that confidence is bluff.

Thursday

Some colleagues feel I should fetch and carry for them. They had to do it when they were probationers. Was shouted down by the 2nd physicist when I argued with him about taking my apparatus prepared for my classes. He was taken to task by the HOD but I overheard him complain that women teachers,'weren't up to the task of working in a department where there had to be a lot of give and take'.

There's been a row between my teacher-tutor and the HOD about my lessons not being supervised.

Friday

Last ten minutes of lesson observed by head of physics. He was very critical that too much time had been spent in the early part of the lesson on getting the kids to explain what they understood about latent heat and why. I was told that I should have prepared some clear blackboard notes, got them to copy them down and set them some work on the notes for homework. Part of the problem was caused by using the department worksheet last lesson. Most of the kids didn't understand the symbols let alone the equations.

Very upset that the problem relates to the mismatch between the teaching strategies I'm told I have to use and the way I think kids learn. Will challenge with the CLISP material.

Worksheets for use with third year just ready as the lesson started. In fact technician had to go and do them at lunchtime. I agreed to collect the various pieces of apparatus together myself. They had been ordered last Friday.

As indicated earlier, the issues raised above were among those experienced by a young teacher during the course of her first year in teaching. It is easy to identify the faults in another department. It is also easy to be smug and assume that 'it wouldn't happen here' but when did you last let a probationer have a 'moan and groan' about their treatment in your school? What is the department strategy for settling in a new member of your staff?

Consider these further questions:

- Do you and/or your colleagues pull rank on junior and/or female staff?
- Are probationers' requests for apparatus and material given as much attention as yours?
- Are departmental guidelines for the ordering of apparatus, materials and worksheets adhered to by senior as well as junior colleagues?
- Are technicians given a reasonable chance to meet the many demands made upon them?
- To what extent are lesson plans discussed before and after the lesson? Are your comments constructive and targeted at issues?
- How do you encourage junior staff to contribute to discussions and avoid them being overawed or frightened by more senior colleagues? Do you ever 'see through' a particular suggestion from a junior? What mechanism do you employ to achieve this?
- How is new research evidence, e.g. that from the Assessment of Performance Unit, considered and discussed by the department?
- Are classes of different ages and abilities shared out fairly? Do you and your senior colleagues take a fair share of the more difficult classes?
- Are insulting and sexist comments made by male staff about female teachers? Are they aware of the insult? To what extent do these views, when expressed, reflect a more deep seated view of science as being male-dominated and orientated?

We know that this last problem is more acute in some parts of the country than others. The extent to which it spills over into areas such as job interviews may well mean that it exists without being recognised for what it is. There is always a danger that in raising this and other issues we will be judged by more enlightened departments

to be uninformed or out of touch. If this is your response then turn to the companion curriculum guide **Better Science: For both girls and boys** and see how this looks from an alternative perspective.

More can be gleaned from the diary; here is another issue it raises. We are conscious that with the best will in the world, many heads of department do not have sufficient time timetabled to allow them properly to fulfil the responsibility for probationers that the school places on them. But although our diary is a one-sided story, we would like to use it to question the extent to which a senior member of a department might be in a position to be very critical of a probationer, when the head of department has a responsibility to ensure a satisfactory level of support for a probationer.

Induction

Many local authorities now have induction schemes in operation within their schools. The earliest were implemented following the publication of the James Report on *Teacher education and training* and the White Paper *Education: A framework for expansion* (**2.5**) in 1972. Two local authorities implemented sponsored pilot schemes for teacher induction in 1974, these were Liverpool and Northumberland. Both schemes gave a reduced teaching load (originally set at 75%) to probationers, appointed and trained working teachers as teacher-tutors to help probationers within the schools, and arranged courses for probationers at centres external to the school (**2.6**); the schemes were evaluated by Colin McCabe and David Hill and their reports identified some interesting features.

Some benefits observed in induction at work

- There was a reduced teaching load for probationers.
- Liverpool set up a permanent team of supply teachers to cover release.
- Probationers valued having someone there specifically to help them.
- School-based activities were highly valued by the probationers as being very relevant to their individual problems.
- In the second year, teacher-tutors were given an active training role.
- INSET for tutors was developed.
- Training materials have been devised.

There were also some problems

- In infant and first schools the reduced teaching loads disrupted the relationship between probationer and class.
- Teacher-tutor and probationer could not always be released at the same time, especially in smaller secondary schools.
- Some probationers lost their release time because it was considered to be free time and they had to cover for absent colleagues.
- The cost in 1974 was high, in terms of the numbers involved.
- There was some conflict of issues with teacher-tutors who were involved in active training *and* assessing probationers.
- Probationers claimed that the induction courses duplicated work done in college. (Some considered this no bad thing, others felt it wasted valuable time.)

Calls for help

The induction programme summarised above has now been operating, with modifications, in Northumberland since 1974. The following brief description of common worries on the part of new entrants to the profession arises from conversations with one very experienced tutor (Ray Stephenson).

During the first term the calls for help tend to be focused on the immediate work in hand. Questions such as 'Am I doing the right thing?' and 'Where do I obtain...?' form the bulk of requests. Much initial advice on the general organisation of the school is necessary, such as timings of lesson bells and assemblies. In addition, lack of knowledge of the geography of a building and the functions of individual parts can cause confusion. The amount of administrative work expected of the newly qualified often causes them some surprise if not outright shock.

It is in the second term that most probationers encounter problems associated with truculent students. They require guidance and sometimes reassurance that their actions are correct and acceptable. Virtually all the newly qualified were given satisfactory support by their subject departments on such matters as content and syllabus and they had found this very helpful in building confidence. Conscientious teachers can be in a state of fatigue at this stage in their career as the job has expanded to fill eighteen hours a day. They find it difficult, if not impossible, to find sufficient time to prepare teaching material and to mark. They often question the efficiency of their teaching and feel that they are doing a lot for little return.

By the time the third term comes around probationers are beginning to look to the future and are concerned about next year's timetable and the classes they are likely to teach. They have also identified some of their professional strengths and weaknesses and are seeking to develop particular talents further.

The experience of the induction period over a time scale of twelve years has been that:

> *The standard of probationary teachers has improved continually. In recent years I have only experienced the most able and thoroughly conscientious people. Their greatest needs have been:*
>
> *(a) to be introduced to the ethos of the school;*
>
> *(b) reassurance that they are conducting themselves in the expected manner.*
>
> (R. Stephenson, personal communication)

Those teacher-tutors who would like further information and advice on operating a school-based induction scheme might like to study *Induction in the Secondary School: A Handbook for tutors* (**2.7**). This particular study covers not only the issues we have raised above but many more besides.

The role of the teacher-tutor

A teacher-tutor would be responsible for the induction programme and the transition of a student-teacher to a fully professional if inexperienced teacher. We see the role of teacher-tutor as one of many facets. These are summarised in Fig. 2.

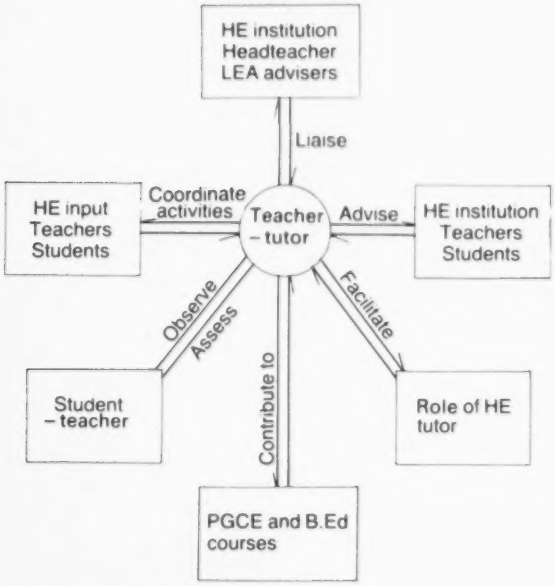


***Fig.2** The role of the tutor-teacher*

A theme within a theme

This section and the questions presented here are for students in initial training and for probationary teachers in particular; they may also be of interest, nevertheless, to experienced teachers and to tutors in HE.

Example A

Your degree course will probably have been in a specialist area like biology, chemistry or physics.

As a teacher you will:

- almost certainly have to teach broadly based *science* and this need is likely to become more acute. Conversion/topping-up courses could be important;
- have to teach science which is related to the experiences of everyday life and you will need to be concerned with topical issues;
- want to bring your own interests and expertise (whether in car maintenance or ornithology) into the classroom;
- need to pick up the new skills, knowledge and techniques needed for teaching applied science such as rural science, health science, microelectronics or biotechnology;
- hope to feel secure when dealing with open-ended problems and concerns ranging from acid rain to algal proteins;
- have to pick up the skills of class assessment as well as basic class management.

Where can you turn to for help? You will naturally begin by drawing on the knowledge and experience of your own colleagues and of your tutors. Further information may be available from:

- ASE publications such as the *Handbook for Science Teachers* (**2.8**), *Rethinking Science* (**2.9**) (teaching science in its social context) and *The School Science Review* (**2.10**);
- SSCR working group products (see the SSCR Directory described in Section 5);
- teachers in other schools, other Higher Education departments;
- school text books;
- the national and local press;
- *The New Scientist* and other popular science journals;
- LEA publications designed for new teachers;
- other books for teachers entering the profession.

Example B

Given the low uptake of physical sciences and engineering subjects by girls and increasing external pressure to rectify this imbalance, what can you do to encourage girls to study physics and physics-based subjects rather than courses leading to medicine, biology and pharmacy,

where they are to be found in large numbers?

What issues could you identify as being significant? Some people suggest that important factors may be the apparent lack, in the physical sciences, of a humanitarian setting or relevance, a sense of caring, the opportunity to contribute a more personal view and to use more personal language, and opportunities to carry out individual or small group investigations. Or perhaps the practical work should be less mechanical and place increased emphasis on communicating?

It may be that too many science teachers are men and that they fail to recognise the needs of the girls.

Do you feel that science educators may negatively discriminate against girls in, for example:

- their use of the formal vocabulary and language of science;
- their attitudes, stances and allegedly cold objectivity;
- allowing boys to push forward and take the best practical equipment leaving the girls to make do with what remains;
- encouraging boys to be practical and girls to write and record;
- listening to boys' views and permitting boys to interrupt or to override the girls' opinions?

You will want to discuss these questions with friends and colleagues. Once you have decided what *you* can do to counter these accusations, to engage the girls more closely in class activities and to arouse their interest, then go on deliberately to plan your lessons to put this into effect. When you are successful tell everyone what you are doing. More experienced colleagues may be encouraged to change their tactics too. The SSCR Curriculum Guide **Better Science: For both girls and boys** is a source of information and ideas.

SECTION THREE

A model for change

Plans for action by teachers

The remainder of this report looks at teacher education against the background of the changes identified earlier. There is an obvious tension here for those in schools: should INSET provision for science teachers be *broad* — covering areas like 'Special needs', 'Language across the curriculum' or 'Multi-cultural' or should it be *subject specific*? Our suggestions (especially in *Identifying special needs* later in this section) reflect national priorities and should ease that tension in some cross-curriculum areas.

Our purpose is to assist both individual teachers and science departments to prepare departmental policies based on their own INSET needs. Normally, these should be in keeping with the whole-school and LEA policy on INSET and in a form which can be submitted to the headteacher or a senior staff member responsible for INSET. Nevertheless, the science department and its individual members should be prepared to take their own initiatives.

The views we express reflect much of the thinking incorporated in the booklet *Making INSET work* (**3.1**) and the 1985 submission to the Secretary of State from the Advisory Committee on the Supply and Education of Teachers (**3.2**). We present a model for in-service education and support which is specifically related to meeting a school-based need, namely that of implementing new science courses that satisfy new educational aims and objectives.

This self-questioning examination of our educational conscience can be a demanding and cumbersome process and we know of no effective short cuts. However, the time spent on discussion and decisions, on development and implementation of plans, can be stimulating both for teachers and students. We hope the students will be given the opportunity and encouraged to be constructively critical of the courses they experience. If this suggestion seems subversive we refer you to *Science is Like a Spider's Web* (**3.3**). Those engaged in the Phase 2 working groups of the Review have found the activity professionally and personally enriching; we do not doubt that all who take part in the wider process will also derive increased job satisfaction from it.

At this point, as we promised earlier, it would be proper to set out what we see as effective INSET. In-service education is not just about attending courses or lectures. Its purpose is:

- to identify problems – in teaching and learning and in the organisation of the curriculum;
- to identify the most satisfactory response to a problem and the provision required to solve it;
- to carry the reform through and to evaluate its effect;
- to encourage reflection on the experience of teaching in the widest sense – a 'global' evaluation.

It may be that these purposes can all be achieved through an appropriate course but it is more likely that other activities will also be needed. For example, the curriculum reform we have in mind could mean:

- reading — exposure to alternative ideas and evaluating those ideas in the context of your own work;
- seeking interesting lectures and seminars outside the formal provisions of a course and, when attending them, contributing to them. (Expertise is not always in the hands of other people!);
- visiting other schools with the intention of actively discussing, surveying and evaluating their curriculum and, if this is possible, observing other teachers teaching;
- carrying out research, practising and evaluating a teaching technique which is unfamiliar to you;
- preparing new teaching materials or apparatus and evaluating their use;
- initiating or joining a working group either in your own school or one supported by ASE region or your local authority;
- seeking and implementing advice on the organisation and running to effective departmental meetings.

The Heads of Science courses (see Appendix I) have utilised a range of tasks and strategies, many of which could be incorporated in the INSET programme of a department or school by a returning HOD. We offer two suggestions.

1 A pre-course discussion group could be set up to engage in activities such as interviewing and observing pupils; following one pupil through their timetable for one school day; consultation with the headteacher about more general matters like the adoption of a common marking system in the school or the development of a common language policy.

2 Prepare a school and department profile. The latter is likely to include basic information and data on curriculum and management patterns.

The information collected in these pre-course tasks then provides evidence for, and a focus on actual school needs as opposed to those defined in response to frameworks and information supplied from outside the school.

Both of these suggested tasks can also be adopted in management courses that involve cross-curriculum groups. For example, time and other support could be provided to enable senior heads of department and the deputy head responsible for curriculum to carry out an analysis of the whole school curriculum.

This kind of activity (and see too Section 4 on agencies and modes of support) allows schools to draw on that expertise of individual teachers, departments and working groups we identified during the development phase of the Review. Both this and the other SSCR Curriculum Guides give immediate access to this experience.

The individual teacher or a department, seeking not to disseminate information to others but to find out how best to respond to the curricular reform envisaged by the Review, will, we hope, find help in this section in the form of guidance on:

- questions that can profitably be raised about the science curriculum;
- how to identify curricular shortcomings or weaknesses; and
- how to build from these a 'needs' list which can be converted into the basis for an INSET programme.

Forming an INSET policy

Our interpretations of educational trends (see Section 1) suggest that it is likely that science HODs will be asked in the future to develop a policy on INSET for their department.

This would normally cover management, organisation, staff and curriculum development. An INSET policy is about change but is only part of an overall curriculum policy. The relationship of the various parts of a curriculum policy are so inter-connected that there is no obvious point to begin nor to end. But such a policy does require analysis and evaluation of the current provision in the school. The Review has provided a framework and advice on how to go about this. The following sets of questions, flow diagrams and checklists are intended as guidance for the HOD. HODs and their departments already have, of course, a full work-load; we expect them to be selective in their response to this guide; some questions and issues will be relevant to them others will not.

Evaluation of current provision can be usefully divided into the following stages and we shall discuss them in this order:

1 Pre-conditions for change.
2 Preparing for change – the crucial issues.
3 Identifying specific needs.
4 A strategy for change.

The order is not prescriptive; once the process of change is underway these stages become cyclic and it ceases to be significant where change begins or ends.

We consider that the process has begun when dissatisfaction with some provision or the identification of a curriculum weakness manifests itself. Beware lest such stirrings are stifled at a very early stage by dismissive remarks, strongly hierarchical line management or poor relationships within a department. If constructive change is to be achieved, then openness, sensitivity and integrity are the order of the day. We consider that careful internal control of the process is vital for very obvious reasons; the morale and development of the profession are at stake, so too is the quality of the service we offer young people.

Some pre-conditions for change

In constructing your own departmental INSET policy you will want to know why change is considered to be necessary and what pre-conditions for change have been identified by the national policy-makers. The three policy documents listed here are well worth your attention.

Science 5–16: A statement of policy (DES, 1985) (**1.2**)
Science Education 11–16: proposals for action and consultation (SSCR, 1983) (**1.1**)
Education through Science. Policy Statement (ASE 1981) (**1.3**)

These documents will provide you with a comprehensive list of questions and issues to discuss within your department. Figure 3 is a flow diagram to help you to structure your discussions. The starting point in this diagram is what we feel will be the issue of over-riding importance at the beginning of your deliberations: 'Do we need to change?'

The crucial issues that emerge from the diagram are:

- whether you have a curriculum policy;
- evaluation of your policy against current LEA and DES policies and the criteria of the SSCR;
- how soon changes will be needed;
- the nature of any changes you need to make.

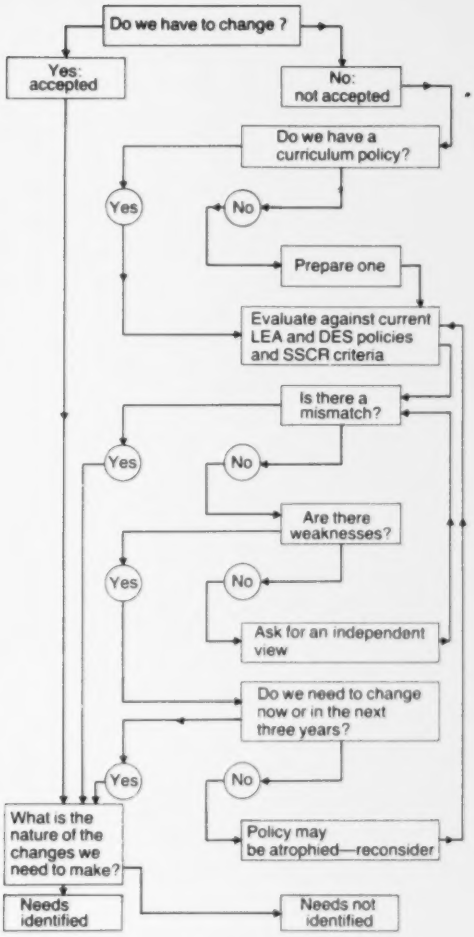


Fig. 3 Do we need to change?

Preparing for change – the crucial issues

The process, we assume here, has now begun. Perhaps this had already been initiated by the school in response to a recent and favourable inspection; the mood being one of optimism and, starting from this high base-line, the desire is to make further improvements to the curriculum. Another school may have begun to change its science curriculum because of the need for re-organisation consequent on falling rolls. The DES policy statement, the climate of discussion and debate, LEA responses and the SSCR may already have exercised the kind of pressure that has led your school to prepare for change.

Do you have a curriculum policy?

Every science department has, or can readily put together, a list of aims and objectives. But are these actually used in developing the curriculum? A proper policy goes much further and would normally include statements at least on the following:

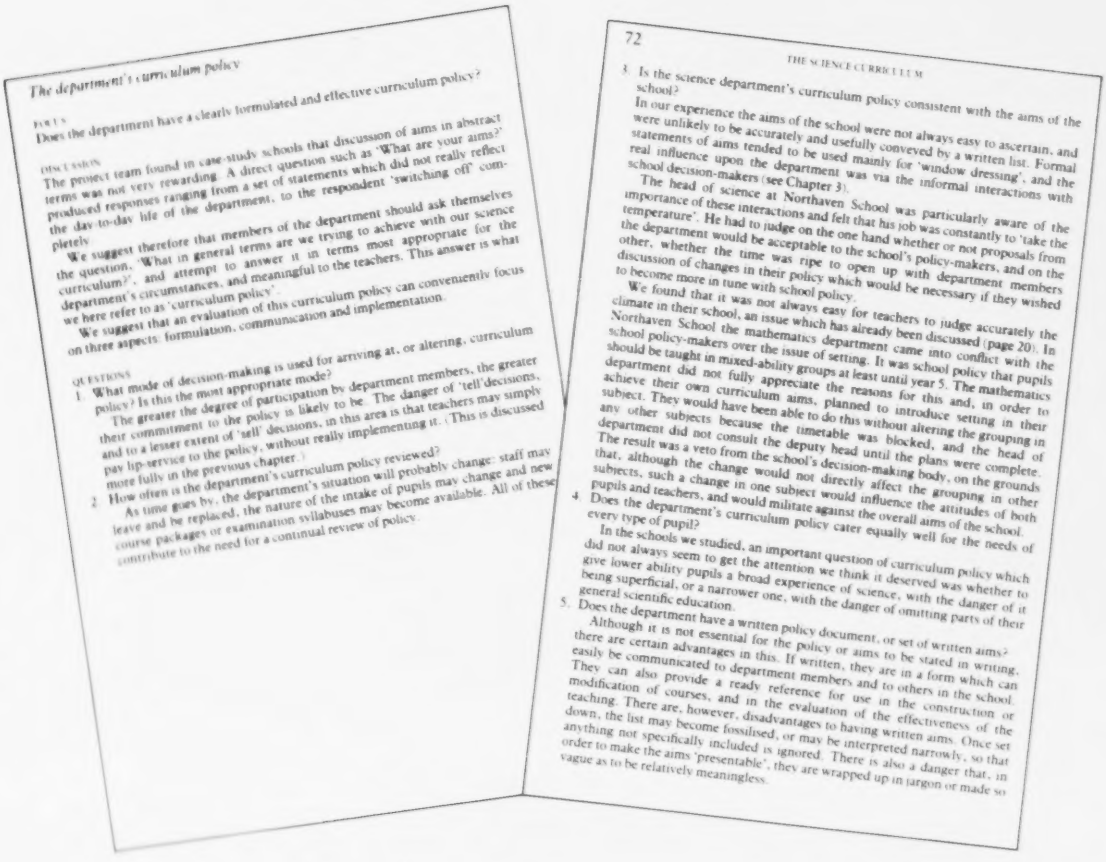
- aims, objectives and various criteria;
- the organisation of the curriculum;
- schemes of work for each course;
- agreed policy and positions on particular issues such as
  - learning theories and opportunities
  - teaching approaches
  - special needs
  - science education of girls
  - multi-cultural aspects
  - monitoring progress
  - differentiation
  - homework;
- the interests and expertise of particular teachers;
- the roles of individual teachers, their
  - job descriptions
  - management responsibilities
  - assessment and profiles;
- examinations;
- school to work links.

If your department does not have such a policy your first task will be to prepare one. The policy documents listed under *Some pre-conditions for change* will give you the basis for constructing such a policy; it can be extended through the use of a wider range of materials. Some of which will be given in Section 5, others can be found in the references and 'Further reading' list. We strongly recommend that you have access to a copy of the **SSCR Directory** where full details of working group products and evaluatory reports can be found.

Evaluation of your policy against current LEA and DES policies and the criteria of the SSCR

Many of you will be aware of the ASE's publication *Decisions in the Science Department* (**3.4**). It is an invaluable book concerned with the core of the curriculum policy. The book has something to offer both in the preparation and the evaluation of your policy. Here we print part of one section, 'Organisation and curriculum', to whet your appetite.

Another valuable source of help, also from the ASE, is *The Science Teacher's Handbook* (**2.8**). A summary of the contents page will show you what it offers. Again, here you will find detailed assistance in the preparation, revision and evaluation of your policy.



The department's curriculum policy

POLICY
Does the department have a clearly formulated and effective curriculum policy?

DISCUSSION
The project team found in case-study schools that discussion of aims in abstract terms was not very rewarding. A direct question such as 'What are your aims?' produced responses ranging from a set of statements which did not really reflect the day-to-day life of the department, to the respondent 'switching off' completely.

We suggest therefore that members of the department should ask themselves the question, 'What in general terms are we trying to achieve with our science curriculum?', and attempt to answer it in terms most appropriate for the department's circumstances, and meaningful to the teachers. This answer is what we here refer to as 'curriculum policy'.

We suggest that an evaluation of this curriculum policy can conveniently focus on three aspects: formulation, communication and implementation.

QUESTIONS
1. What mode of decision-making is used for arriving at, or altering, curriculum policy? Is this the most appropriate mode?

The greater the degree of participation by department members, the greater their commitment to the policy is likely to be. The danger of 'tell'decisions, and to a lesser extent of 'sell' decisions, in this area is that teachers may simply pay lip-service to the policy, without really implementing it. (This is discussed more fully in the previous chapter.)

2. How often is the department's curriculum policy reviewed?

As time goes by, the department's situation will probably change: staff may leave and be replaced, the nature of the intake of pupils may change and new course packages or examination syllabuses may become available. All of these contribute to the need for a continual review of policy.

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THE SCIENCE CURRICULUM

3. Is the science department's curriculum policy consistent with the aims of the school?

In our experience the aims of the school were not always easy to ascertain, and were unlikely to be accurately and usefully conveyed by a written list. Formal statements of aims tended to be used mainly for 'window dressing', and the real influence upon the department was via the informal interactions with school decision-makers (see Chapter 3).

The head of science at Northaven School was particularly aware of the importance of these interactions and felt that his job was constantly to 'take the temperature'. He had to judge on the one hand whether or not proposals from the department would be acceptable to the school's policy-makers, and on the other, whether the time was ripe to open up with department members discussion of changes in their policy which would be necessary if they wished to become more in tune with school policy.

We found that it was not always easy for teachers to judge accurately the climate in their school, an issue which has already been discussed (page 20). In Northaven School the mathematics department came into conflict with the school policy-makers over the issue of setting. It was school policy that pupils should be taught in mixed-ability groups at least until year 5. The mathematics department did not fully appreciate the reasons for this and, in order to achieve their own curriculum aims, planned to introduce setting in their subject. They would have been able to do this without altering the grouping in any other subjects because the timetable was blocked, and the head of department did not consult the deputy head until the plans were complete. The result was a veto from the school's decision-making body, on the grounds that, although the change would not directly affect the grouping in other subjects, such a change in one subject would influence the attitudes of both pupils and teachers, and would militate against the overall aims of the school.

4. Does the department's curriculum policy cater equally well for the needs of every type of pupil?

In the schools we studied, an important question of curriculum policy which did not always seem to get the attention we think it deserved was whether to give lower ability pupils a broad experience of science, with the danger of it being superficial, or a narrower one, with the danger of omitting parts of their general scientific education.

5. Does the department have a written policy document, or set of written aims?

Although it is not essential for the policy or aims to be stated in writing, there are certain advantages in this. If written, they are in a form which can easily be communicated to department members and to others in the school. They can also provide a ready reference for use in the construction or modification of courses, and in the evaluation of the effectiveness of the teaching. There are, however, disadvantages to having written aims. Once set down, the list may become fossilised, or may be interpreted narrowly, so that anything not specifically included is ignored. There is also a danger that, in order to make the aims 'presentable', they are wrapped up in jargon or made so vague as to be relatively meaningless.

Fig. 4 Extract from Decisions in the Science Department(3.4)

Contents (2.8)

Chapter 1 Why teach science and why to all?
Chapter 2 How is science teaching structured?
Chapter 3 How is science taught and learnt?
Chapter 4 How is science teaching evaluated, assessed and examined?
Chapter 5 How is science teaching organized?
Chapter 6 How are resources organized?
Chapter 7 Special problems
- Students with special needs
- Science education and ethnic minorities
- Links across the curriculum
- Safety in school science laboratories
- Science in the 14-18 curriculum
- Girls in science

Do we need to change now or in three years time?

Don't be lulled into a false sense of security. If you think you are going to change in three or four years time we suggest you start now. The first thing to do is to begin to identify and list your INSET needs in an order of priority. You will not be able to structure and implement change at a stroke, nor will other factors allow it. Look at change as a process; an immediate start should guarantee classroom change in less than three years.

What is the nature of the changes you need to make?

We are going to look at these next in the light of determining specific needs. The underlying principle in considering this vital issue is that we are all engaged in seeking an improvement to the quality of teaching and learning in our school.

Identifying specific needs

SSCR warning
This section can seriously damage your curriculum stability

In developing procedures which will lead to an INSET policy there is a serious risk of you (the HOD) overloading yourself (and others) with information and work. We strongly suggest that you initially identify particular curriculum issues which will be of immediate priority for you and concentrate on developing these, perhaps one at a time. Perhaps you can delegate specific tasks to individual colleagues in the department or, if the department is large, working groups could be set up each with the defined task of tackling specific areas. Some of the issues that we consider to be of high priority are listed below. (Again, we do not seek to be prescriptive but to offer guidelines.) The time scheduled for such work must take into account obvious constraints like the frequency of meeting, the work to be done between meetings, the length of time for consultation and negotiation (bearing in mind that this may involve people outside the school) drafting, redrafting, disseminating and implementing the policy. The level of moral and organisational support and interest offered by your headteacher will also affect timing. It is, therefore, not possible to say how much time will be needed but a sensible step would be to draw up a calendar or diary of events when you begin and to map progress as time goes by. (See *A strategy for implementing change* below.) For further help in setting up and operating a working group see (Chapter 2 in **1.5**).

It must be stressed again that there are no easy and uniquely satisfactory answers to the questions you will have to consider. Our advice is not to attempt too much at any one time and not to embark on wide-ranging tasks in the first instance.

The issues we have selected are set out in boxes on the following pages. Each one begins with a quotation which places the issue in context. This is followed by a set of questions to provide focal points for your reading and discussion. Finally you are directed to one of the SSCR Curriculum Guides which are companions to this one. There you will find a fuller treatment of the issue and, perhaps, of related issues, together with other source material.

It is for you to acquire the knowledge and expertise needed successfully to bring about the desired change. We can only offer guidance and information; the decisions are for you. Use our boxed issues as a directory, picking one out as and when you are ready to develop it and set it in the context of a single or at most a double year group at a time.

The overall aim of this exercise is the implementation of a broad and balanced science education for all 11—16 year olds and your school will be required to adapt curriculum practice in line with this new national policy set out in the documents referred to earlier. You are not likely to be on your own in this exercise. The Review's working groups, LEA and inter-school based developments and the INSET work for the GCSE have all been co-operative undertakings and it is within this kind of framework that each school will set about its task.

A directory of issues and treatments

Aims, objectives and criteria (Box 6)

A balanced science curriculum (Box 7)

Approaches to teaching and learning (Box 8)

Relevant and applicable science (Box 9)

Organising science in the curriculum (Box 10)

Special needs (Box 11)

The science education of girls (Box 12)

Multicultural science education (Box 13)

Assessment, reporting and examining (Box 14)

Management and resources (Box 15)

Evaluation (Box 16)

Health and science education (Box 17)

The primary–secondary interface (Box 18)

Courses which had clearly set out aims and objectives, were more successful than those without. (HMI Secondary Survey, 1979) **(3.5)**

- What are the similarities and differences between your science department aims and those of
  (a) The Secondary Science Curriculum Review?
  (b) The DES Policy Statement?
- What major areas do the SSCR and DES aims promote that are not reflected in your department's aims?
- What arguments would support a level of change to enable these 'missing' areas to be included?
- Using your objectives as a starting point identify within the scheme of work of the age group concerned where the objective is most likely to be achieved.
- What is the degree of congruence between your aims, the teaching strategies suggested to achieve them, the teaching content and the assessment procedures? Limit your discussion to one aim at a time.
- Is there congruence between your aims and those for the GCSE science examinations? (4th/5th year only.)
- Is there conflict between the two sets of aims? If so what can you do?
- Is there congruence or conflict between the departmental aims and those of the school? If they are conflicting, what can be done?

Source material can be found through *Issues in Science Education: a bibliographic survey* (section 3.1 of **3.6**) and the SSCR group material *Reviewing practice in the 11–13 science curriculum. Unit one: Clarifying aims — defining goals* (**3.7**)

Further details are found in
SSCR **Better Science: A Directory of Resources** (Heinemann/ASE, 1987)

Box 6 Aims, objectives and criteria

...If science is to be taught to convey understanding, and confidence in the use of knowledge gained, as well as the necessary and central skills, both practical and intellectual, then the factual and theoretical content of many existing courses will need to be sharply pruned. **(DES,1985)(1.2)**

- Is the curriculum content broad based? That is, are the concepts, processes, skills and attitudes taken from a full spectrum of science disciplines and not only biology, chemistry and physics? (Consider one year group at a time.) The full 11–16 age range will give you some idea of the students' entitlement.
- What attempt has been made to reduce the amount of factual content so as to provide more time for alternative teaching strategies and the development of processes, skills and attitudes?
- If you have attempted this reduction, what criteria did you use?
- Can you make a statement which identifies the balance between concepts and process in your scheme? This is far from simple but should be addressed. Is this balance
  (a) acceptable to you
  (b) acceptable to your colleagues
  (c) compatible with national statements on the science curriculum?
- Compare your list of processes and skills against those listed in the curriculum guide (see below). Are any important ones missing from your list? How can you include them in future?
- To what extent is the work in question relevant to the short and long term needs of the student?

Further details are found in
SSCR Curriculum Guide **Better Science: Choosing content** (Heinemann/ASE, 1987)

Box 7 A balanced science curriculum

The selected (teaching) techniques need to give the teachers professional satisfaction and make the best use of the knowledge and skills of all members of the department. At the same time, they must also be effective in achieving the aims of the curriculum **(3.4, p.92)**

- Is a wide range of teaching approaches being used, across the ability range, in order to achieve the various learning outcomes?
- What mechanism exists to introduce new approaches to teaching science?
- Has consideration been given to alternative approaches to learning?
- What teaching strategies are commonly used with success elsewhere in the school? Which of them would be appropriate in science?
- Invite colleagues to write down four statements which reflect their understanding of the way children learn. Be prepared to do this yourself. Discuss these views openly and compare them with the recommendations suggested by the Children's Learning in Science Project. What conclusions do you draw and how will these affect the teaching strategies adopted in the department?
- What has other, recent research work told us about
  (a) the way children learn and
  (b) the use of practical work as a means of assisting the learning process?

Further details are found in
SSCR Curriculum Guide **Better Science: Approaches to teaching and learning** (Heinemann/ASE, 1987)

***Box 8** Approaches to teaching and learning*

Above all, the justification for including societal material in the science curriculum is that it helps make science more interesting and enjoyable. We should be showing our pupils the relevance of science to the every day things with which they are familiar. In this way science becomes less mysterious and more a real-life, human activity. (p.2; comment by a teacher) **(2.5)**

Work of the highest quality was observed where the science taught was related to its applications in life generally and where the pupils were helped and encouraged to use their scientific knowledge to solve scientific and technological problems appropriate to their age and ability. **(Para 46, p.20; an HMI enquiry) (3.5)**

- How far does your teaching reflect human issues connected with science and technology? In what ways do you include societal material in your courses?
- What broad agreements have you reached with colleagues about what technology is and how it relates to science?
- School technology tends to be heavily biased towards physics and engineering. What steps do you think can be taken to promote technological work which reflects the importance of chemistry and biology and other sciences?
- To what extent do science courses in your school provide opportunities for pupils to engage in investigative and problem-solving activities that are open-ended to various degrees?
- If you take a scheme of work for one school year, can you identify topics which could be made more interesting by relating them to technological applications and social implications?

Further details are found in
SSCR Curriculum Guide **Better Science: Making it relevant to young people** (Heinemann/ASE, 1987)

***Box 9** Relevant and applicable science*

Teachers must take on the roles of curriculum planners and developers if they are to maintain control of teaching and learning. **(3.9)**

- Will new patterns of subject organisation be required to meet the policy of 'science for all'?
- If you are in doubt classify your current provision of science in the curriculum under the following three headings:
  (a) timetable
  (b) subject matter
  (c) learning approaches.
- Do the above patterns of classification meet the policy of broad, balanced science for all?
- If not, what are your choices of curriculum models in each of the categories above?
- What are the likely problems and consequences of making a change in any one of the categories?
- What organisational frameworks will assist in the development of links between science and other areas of the curriculum?

Further details are found in
SSCR Curriculum Guide **Better Science: How to plan and manage the curriculum** (Heinemann/ASE, 1987)

***Box 10** Organising science in the curriculum*

It would seem at first sight that science should hardly be considered relevant to these students whose understanding of and expressive use of language is likely to be below average for their peer group as a result of their physical disabilities (e.g. deaf, partially sighted or motor difficulties) or mental disability and concomitant lack of experiences.

I would argue most strongly that this is not so. Science when regarded as a vehicle for teaching life skills, not as a series of facts to be learnt, can be one of the most powerful subjects in the curriculum for the development of general language skills, observational skills, classification skills, awareness of cause and effect and reasoning skills. **(3.10)**

- What provision needs to be made in your science work areas to accommodate and promote the science education of physically handicapped students?
- What policy do you have to identify and support the science education needs of:
  (a) those with learning difficulties?
  (b) gifted children?
- To what extent is the curriculum provided for those with learning difficulties set in a 'real-life' context that is familiar to the student?
- What information do you need to know about students with learning difficulties before they start their first year with you?

Further details are found in
SSCR Curriculum Guide **Better Science: For young people with special educational needs** (Heinemann/ASE, 1987)

Box 11 Special educational needs

We did some experiments on Ohm's Law, and the law of gravity and things like that. You know it's all laws. You can't find out new things about laws can you? When they've been discovered by famous men, they're not going to be wrong are they? (Interview with a 14-year-old girl) **(3.11)**

The greater concern that girls express for social issues should be utilized, for who can deny the importance of such considerations also in the science education of boys? **(3.12)**

- List the articles or books you have read during the last year that relate to this issue.
- Following your reading and discussions in this area, what changes are necessary to meet the legitimate needs of girls in relation to their science education?
- Place these issues in order of priority.
- What needs to be done to implement (say) the first two changes?

Further details are found in
SSCR Curriculum Guide **Better Science: For both girls and boys** (Heinemann/ASE, 1987)

Box 12 The science education of girls

The multicultural approach accepts that western science is a powerful tool with which to study the world but acknowledges that not all groups have equal access to it; it attempts to draw attention to the contribution of other cultures to science and technology throughout history. **(3.13)**

- Identify from your current schemes those issues which can be viewed from an alternative cultural viewpoint.
- Encourage your colleagues to use a checklist to identify any cultural bias in the resources you currently use.
- What are the arguments in favour of your curriculum including science issues and processes taken from cultures other than Western Europe?
- How can you justify this especially if your school is not serving a multicultural catchment area?
- What arrangements need to be discussed and planned to enhance the science education of young people from a variety of cultural and ethnic backgrounds?

Further details are found in
SSCR Curriculum Guide **Better Science: Working for a multicultural society** (Heinemann/ASE, 1987)

Box 13 Multicultural science education

That assessment should be a formative part of a coherent educative process and not regarded as merely summative.

That for assessment to be formative results have to be available to the learner in such a form that she/he can work towards the improvement of performance. **(3.14)**

- Have you decided on your teaching objectives and strategies and matched your assessment procedures to them?
- When are these assessment procedures formative and when summative?
- Are there procedures which are suitable for all students in the school?
- Is there a common marking or grading system operated by all staff?
- Have the assessment objectives and science department grading schemes been explained to your students?
- Are these objectives accessible to and understood by parents and other teachers in the school?
- What mechanisms have been adopted to report assessments and progress to students, parents and others?
- Do you use a wide range of assessment techniques in your department?
- What part does the science department play in developing students' records of achievement and profiles?
- How do the summative assessments (say in GCSE) reflect the whole rationale of your courses?

Further details are found in
SSCR Curriculum Guide **Better Science: Assessing progress** (Heinemann/ASE, 1987)

Box 14 *Assessment, reporting and examining*

Many – but by no means all – of the developments necessary will require extra resources, and the pace of progress is bound to depend on the rate at which those resources can be made available. **(DES, 1.2)**

- Have the resource implications of the new course been identified?
- Do the science staff have the required skills to manage the resources creatively?
- Has consideration been given to the efficient development of existing resources?
- The management of change requires certain skills. From your reading assemble a list of (say) five or six of the most important. Where and to whom can you turn for assistance to develop these skills in your department?
- How do you currently negotiate your resource needs? Do you accept what you are given or do you have a well argued case for the needs you identify?
- How aware are you of the financial limitations that the LEA and school are operating under?

Further details are found in
SSCR Curriculum Guide **Better Science: Key proposals** (Heinemann/ASE, 1987)

Box 15 *Management and resources*

'In all my previous schools, Headmaster (puff), I've never had to negotiate my departmental allowance like this!'

- In developing your in-service policy have you discussed and agreed specific and pertinent criteria, against which the effects of change can be monitored after implementation? In other words, has an adequate strategy been evolved to evaluate the INSET activity?
- Who will do it? What is the purpose of the report? Will it be formative or summative? What form of report will be forthcoming?
- Who is the audience for the report? To whom (in addition to the primary audience) will the report be circulated?
- When in the cycle of activity will the report be presented?
- The success of this current enterprise depends to a large extent on the success or otherwise of the departmental (or LEA) groups assigned the various tasks. What can a school-based group learn about this process from the experience of the Review working groups?

Sources to help you in the process of evaluation.

Curriculum Evaluation in Schools, McCormick R. and James, M.E.,1984 (**3.16**) and *Evaluating the Curriculum of the Eighties*, Skilbeck, M.(Ed.), 1984 (**3.17**)

Box 16 Evaluation

- The two main headings under which health education aims can be subsumed are:
  personal development and
  awareness, knowledge and understanding.
- What aims for the personal development of young people are found in your curriculum?
- What teaching strategies do you employ in order to achieve these aims?
- Have these strategies been successful in the past? If not, can you identify the conflicting issues?
- How does your curriculum encourage youngsters to use their scientific concepts to make decisions about issues concerning health.
- How does your curriculum help youngsters to analyse conflicting arguments about health and disease in a way which will help them to choose courses of action most likely to enhance their health.
- Health in the context of science education, as articulated by the Review (and others), indicates an increasing autonomy in the learning process as young people progress through the school. To what extent is this reflected in your curriculum?

Further details are found in
SSCR Curriculum Guide **Better Science: Health and science education** (Heinemann/ASE, 1987)

Box 17 Health and science education

- How do you build onto the *information* supplied by primary schools?
- The quality of science education experienced by an increasing number of primary children is much higher than it was ten years ago. This development places an added responsibility on the secondary school science department. How will you build onto the students' early *experience* so as to ensure continuity and progression?
- How do children and teachers spend their time studying science in primary classrooms?
- Although there is likely to be a science co-ordinator in the primary schools in your area, most primary teachers teach some science. Do you know what perceptions they have of the science that goes on in your school?
- Have you considered a joint INSET programme with your primary colleagues? What form could the sessions take and what would be the benefits?

Further details are found in SSCR Curriculum Guide. **Better Science: Building primary–secondary links** (Heinemann/ASE, 1987)

Box 18 *The primary–secondary interface*

A theme within a theme: negotiating change

We introduced *A theme within a theme* at the end of Section 1. Here we re-visit the two examples we chose. We have been pursuing aspects of change through the medium of an INSET policy. Here we would like to switch from more general considerations to the specific issues in our two examples.

It seems to us that the first stage is to consider the changes that will have to take place — always assuming that the need for change is accepted.

Example A

You might be a whole department about to undertake a 'double subject approach' in years four and five. You might be chemists about to teach some earth sciences, or a biologist about to tackle some electronics. How do such changes affect the school and the science department? You will have to develop a strategy, and plan out the actions that will need to be taken. Your first step is to identify the problems and demands the changes will create. In this sense, it is worth asking some such general questions as these:

- Can you and your colleagues draw up a list of the particular requirements involved when teaching a specific topic, or range of topics?
- How often should you and your colleagues revise this list and how can this best be done?
- Who is best placed to give advice both within the school and outside it at local (LEA), regional or national level?
- Is there any resource material that can be used?

Another general need may be to ensure the cooperation of those colleagues who have useful experience or who may be affected by the changes you are initiating in the science department. Will it be necessary to inform others — and to keep them informed of the progress you are making and how much INSET time the changes will take? Will all your activities remain on the site or will you need to go off-site?

Specific needs analysis:

1 What is the shape and organisation of the teaching you are about to take on, e.g. is it the health education parts of the first year course; all the third year electronics; or an examination option in biotechnology? (See **Better Science: A directory of resources,** Heinemann/ASE, 1987)

2 Is there a similar course already in action, has someone already drawn up an outline curriculum?

3 Are you setting out to develop a programme from scratch? Say, for example, that you want to broaden your third year teaching (two groups of twentyfive each week) by developing a half term's work in geology. You decide that it will:
(a) be process oriented and practically based as far as you can make it;
(b) include some project work;
(c) involve an end of term fieldwork outing;
(d) subsume some of the work you normally introduce on metals and ores. Let's imagine too, that your own familiarity with geology is fairly rudimentary.

Your INSET needs now revolve around gaining access to: training resources such as materials, equipment and technician time, and information; training in practical geology; experience in field-work; and other forms of support.

Example B
You might be a department keen to encourage more girls into the physical sciences. Many of the general questions you may begin by asking will be similar to those for Example A:

- Will the steps you take to encourage girls have broader implications for your teaching?
- Can you identify the teaching implications of a particular innovation you would like to see brought about?
- Will they stretch resources or affect your colleagues; How can you review your needs and those of your colleagues?
- Who is best placed to help you review your progress and to help you implement the new strategies?

Making special provision for any group within a school is often a sensitive issue. The problem of girls and science has generated considerable controversy and there is little reason to consider that all disagreements are now ended. In this case you may need to talk to your colleagues in school, and parents and governors outside, about what you are doing.

Specific needs analysis

1 Identify major issues and concerns. (The publications listed in Box 12 will help you.) In addition, the work of SSCR groups such as *Time for Change* (**3.20**) may give some helpful pointers.

2 Look at the particular constraints in your own school — at the syllabuses available; the school rationale; the staff — in the context of the science education girls will receive.

3 Devise strategies which will help to redress the balance and encourage girls to develop their interest in all branches of science.

A strategy for implementing the change

The needs are identified; how are the necessary changes to be implemented? Some solutions are more appropriate than others, can be more easily supported and are more likely to be successful. The whole exercise may already have arrived on uncertain ground where there are more questions than answers and success is going to be dependent on how well the analysis and evaluation of current provision was carried out. But the process is now well under way, and to carry the process through now to a successful conclusion help will be needed by all but a very few departments. Help must be sought either through the sources detailed in Section 4 or through one of the many means of in-service development we listed earlier. But before you begin the plan for implementation be certain of the *nature* of the change you are engineering.

There must be a **clear agreement as to the nature of the change** identified. Is it **organisational, managerial** or primarily **related to the curriculum**? Is it in keeping with national and local guidelines?

If, for example, one of the changes is seen to be managerial then it would be wise to address that problem first before moving to any other. Should you now list your identified needs in order of priority?

The strategy we suggest is set out in the form of a table of questions (Box 19). This can be copied, amended or extended as suits.

'What exactly have they been **doing** *in second-year science?*

Issue/problem/question

- Who in the department will be responsible for the various elements of the policy? We suggest you list the elements of the reform (see *Identifying specific needs* above) and link them to named staff.
- What is the desired timescale for the introduction of the new order?
- What does an analysis of the support and resources indicate will be needed to implement the change?
- Has the department formulated a plan for mobilising internal and external support and resources?
- What effects will this change have on the rest of the school curriculum? Has the department reached agreement with regard to the changes it is proposing?
- Are other curriculum areas also considering similar changes?
- To what extent will addressing the problems on a whole-school basis increase the chances of meeting the needs of the school?
- Have the proposals been fully negotiated with
  parents,
  employers
  governors
  the students themselves?
- What criteria will you use to evaluate the effects of the change?
- How and when will you know if you have arrived?

***Box 19** Planning*

Finished - now what?

SECTION FOUR

Seeking support

Support agencies

Assuming the department, after full and open discussion, has identified its needs, priorities and the required resources, where is support available to assist in this process of change? To whom can teachers turn for help in developing an INSET programme? We suggest that you try not to skip through this section assuming it is all too familiar to you; suggestions that might seem a trifle obvious can easily be overlooked.

Other teachers in the department; but not only the head of science although s/he is most likely to be aware of the particular strengths and expertise present in the department. Very often newly appointed teachers may have carried out a special study that could contribute much to the solution of a problem. Other science teachers who have followed a courses of study for a higher degree, or have built up expertise in special fields should be encouraged to share their experiences. Do you all know each other's curriculum strengths and interests?

Some teachers in other departments are likely to have skills that would be of value to science staff, for example, in particular teaching strategies. Small group discussion method may be less familiar in the science department; can you tap the expertise and professional standards of the **English department?** Try to observe some English small group teaching and follow this up by a joint departmental meeting. How useful some kind of directory of expertise and techniques (perhaps covering all the schools in an authority) would be!

The Headteacher may be a valuable source of contacts in the local community and this avenue should be explored.

The expertise of **teachers in other schools** who have taken on similar specific tasks is a resource that should not be ignored. One of the strengths of the local working groups in the Review was that they enabled people with various talents to come together to address a problem of mutual interest. Can such co-operative links with other local schools be fostered?

Science and other advisers are obvious sources of help. In most parts of the country science advisers from LEAs across a region already meet at regular intervals. What is needed is a mechanism for making this expertise more widely available. One way, of course, is for one adviser to invite another to meet and address their science teachers on an issue of mutual interest. We would include here the **wardens in Teachers' Centres.** Although their roles and expertise vary they can be an invaluable source of contacts, ideas and general organisational help.

Lecturers in education and **INSET tutors** in colleges, polytechnics and universities could be approached, at an early stage in any INSET programme planning (as possible evaluators perhaps). Schools may not ordinarily be part of any formal relationship that assists between the LEA and the institution of Higher Education. Much could be done to develop a tripartite relationship. The department may call on a **range of consultants** to visit the school to assist in aspects of its development work. Suitable consultants may be senior staff from other schools, science advisers and advisory teachers, officers of examination boards, tutors in colleges and departments of education, representatives of local industry, of local employees, of trades unions, of SSCR personnel. This option will almost certainly require detailed negotiation not only with the headteacher but also the advisory staff of the LEA.

Parents, governors of schools and **local employers** should not be overlooked as a sources of advice and support. Apart from informing and involving them in INSET planning there are political advantages in having their support in the community when major changes are afoot.

Subject teaching associations such as the Association for Science Education continue to provide a range of invaluable support material both in printed form and (through its regional network) a regular programme of meetings which cover all aspects of the science curriculum. For example, articles in *School Science Review* and *Education in Science* lead to widening contacts. Do the best departments have the best contacts?

The Department of Education and Science and **Her Majesty's Inspectorate** have produced at regular intervals a variety of publications which can be useful not only in curriculum analysis but in the matching of current practice to policy.

Experience during the development phase of the Review points to your local **SATRO (Science and Technology Regional Organisation)** being able (and willing) to provide contacts and other expertise.

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itself incorporates a wide variety of expertise. Apart from publications (see Section 5), the working group members, conveners, co-ordinators and Central Team personnel, collectively and individually, should be considered as a resource to be tapped.

Finally, and most importantly, have you considered asking the **students** themselves? Perhaps better than anyone else, they could well have an idea of how the curriculum is meeting their needs and what might be done to improve it.

Modes of support

In order to effect change in the classroom, teachers, departments and schools need to have access to a wide range of in-service support other than individuals or bodies. These would include not only such published resources as articles, books, audio-visual and information technology, but also the invaluable resources of a more intangible nature which arise from interaction within a working group. We are looking for something that is certainly school-focused and may well be school-based.

The process and practice of developing an INSET programme can take many forms, for example:

1 The department may use a **parents evening** or a **parents' science workshop** to inform parents and students of proposed changes and to get evaluative feedback on them.

2 Departmental **staff** may organise a series of evening **workshop/seminars** directed at the issue of course design. These workshops may involve staff from other departments or from other departments or from other schools.

3 The department may use an **INSET day(s)** to write up a key element of a new course, or use such time to explain and negotiate new course proposals with the rest of the staff.

4 One strategy that has been successful in the past is the **school** or **department INSET weekend** when, given proper pre-planning, many issues can be discussed and negotiated in a relaxed atmosphere.

5 In association with the LEA and a number of schools, members of the science department may establish a **working party** to develop a common approach in a group of schools. Alternatively, departments or individuals, with the support of their LEA and in association with schools across a region or district, may address **issues of common concern,** for example, in connection with a new examination system. This kind of enterprise will need funding and support. It is no longer reasonable to expect that most curriculum development work will be in teachers' own time.

6 Invited **consultants could visit** the department to assist in an analysis and evaluation of the curriculum and the development of INSET strategies.

7 Members of the department can **visit in pairs**, a range of **other schools** when preparing to make a decision on a particular issue.

8 Much use can be made of the various **distance learning** courses offered by institutions such as the Open University and the University of Surrey. In connection with some distance learning courses there are many excellent **radio** and **television programmes** which can be utilised without having enrolled on the particular course.

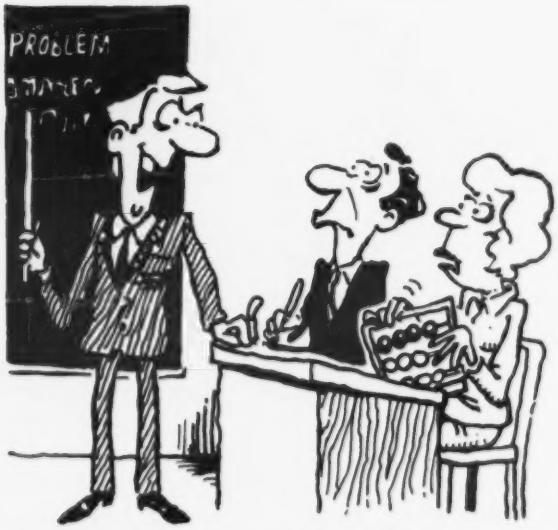
9 Finally, there are the traditional sources of school-focused INSET such as **HMI Short Courses, DES Regional** and **LEA designed courses.** Many teachers will still wish to make use of **higher degrees, diplomas** or **certificates** offered by the higher education institutions, although the pattern of such courses is changing as a result of the new INSET policies and mechanisms of funding.

What about the money?

Planning involves budgets; for a particular school this means dependence on LEA policies and funding. The school can do three things in preparing their case. First, it is necessary to cost the INSET proposals as accurately as possible; a costing expert should be available in school, i.e. the headteacher or deputy head responsible for INSET. Second, it will be necessary to incorporate evaluation into any bid for grant money. Third, the department should aim to have all the policy planning discussed, agreed and ready to implement as soon as the money becomes available.

Clearly medium and long-term planning are essential for INSET work. Let us refer you back to Section 1: *The changing nature of in-service education*. Money will be available through the new funding mechanisms (England and Wales only) to support school-based and school-centered in-service education. Those departments which can prepare a detailed and well argued case for a particular development are more likely to be successful.

A further source of funding for developments at school level is the traditional one of seeking industrial support. However, some curriculum bodies (for example, the Centre for the Study Of Comprehensive Schools and the School Curriculum Development Committee) have made small grants available to support curriculum-based initiatives in school.



'Ready? If a Head of Department's capitation allowance has stayed the same for four years, while the cost of textbooks has doubled, how many PTA Jumble Sales are needed to enable the said Head of Department to implement a new GCSE course?'

SECTION FIVE

Matching SSCR provision to your needs

Let us assume that the development of your INSET programme commenced with an analysis by teachers of specific needs and that reflection, discussion and policy preparation have followed in a well-organised fashion. We hope you have found our guidance, information and detailed advice helpful. We would like to be confident that teachers, departments, schools and LEA advisors are using the SSCR publications to the full; this chapter is a brief survey of their content.

The SSCR Curriculum Guides

In terms of whole-school curriculum management, headteachers, senior teachers responsible for the curriculum and advisers should turn first to **Better Science: Making it happen,** a companion publication to the Curriculum Guides.

This addresses the issues of curricular provision, learning and teaching environments, assessment, resources, staff development and decision making in a whole-school context. Here will be found a summary of the basic findings of the Review, an indication of good practice, identification of the decisions that have to be taken and advice on evaluating change. This book is written for a wide audience in order also to interest non-science people who have responsibilities for managing and resourcing schools. In turn, **Better Science: Making it happen** reflects the structure of the following series of Curriculum Guides (of which this is one) written for the science teacher (at class and department level). These resource books derive much of their authority and value from the work of SSCR working groups and the combined expertise of the Central Team and Steering Committee. They address the following areas:

- **Better Science: Key proposals**
  This is an introduction to the SSCR and its ways of working; it briefly summarises the main recommendations of the Review relating to science for all young people; discusses the resources needed at school, LEA and national levels; gives a bibliography for use with any of the SSCR Curriculum Guides; and contains an overall index for the set of guides.
- **Better Science: Choosing Content**
  Calls for 'broad, balanced science for all' and 'process not product', along with demands to 'reduce content', all make the task of deciding what to teach in school science complex. This discussion document considers many of the claims on science and offers some solutions and exemplars in the light of work by SSCR groups.
- **Better Science: Making it relevant to young people**
  This guide examines questions such as:
  How can school science be made more pertinent to youngsters' thinking and everyday living?
  How can we teach the process of applying science?
  What is the role of technology studies in the science curriculum?
- **Better Science: Approaches to teaching and learning**
  This report is written by experienced practising teachers and describes, through the use of case studies, ways in which a broad range of approaches to teaching and learning can be used to enhance students' learning in science successfully.
- **Better Science: How to plan and manage the curriculum**
  As a help for teachers engaged in planning for broad and balanced science courses, this guide addresses timetabling, organising the subject matter, programming the learning, modular approaches and alternative contexts for science education.
- **Better Science: For both girls and boys**
  This is a summary of the main findings of recent research projects into the responses girls make to physical science, which also have implications for boys. Practical suggestions are provided for teachers to enable them to address the problem for themselves.
- **Better Science: Working for a multicultural society**
  Here the focus is on a relatively new item on the agenda of science educators. It uses a series of articles to raise particular issues and provides practical examples of curriculum development work to date. The message of this guide should inform the practice in all science departments.
- **Better Science: For young people with special educational needs**
  This guide reflects the importance of improving provision of science education for children with

learning difficulties. It is set in the context of special education, which has seen major changes since the publication of the Warnock Report. The emphasis is on identifying and responding to individual needs.

- **Better Science: Health and science education**
  The concern here is with what is understood by health and health education. Where, when and how does health education take place in the science curriculum? Who teaches it and how can teachers assess and evaluate it?
  The guide uses case studies to show how science teachers working with the Review have implemented many of the suggestions and recommendations made.

- **Better Science: Building primary-secondary links**
  This guide attempts to answer the following questions:
  What kind of science goes on in primary schools?
  What skills does good primary science give children by the age of transfer?
  How do secondary schools build on this?

- **Better Science: Assessing progress**
  The key issues of assessment are discussed and updated in response to developments both inside and outside the Review. It is set in the context of the Review's belief in the need to change the emphasis to formative, criterion-referenced assessment.

- **Better Science: A Directory of Resources**
  This is where to find out about classroom-based or pupil material. Here you will find details of all SSCR working group products or outcomes that have met the Review criteria.
  A systematic index is included in this Directory.

Responses to and evaluation of the SSCR

- *A Report on the responses to the consultative document* (Bentley, D. and West R.W., SSCR; in preparation)
- *Flags at the front; spears up the rear.* A report on the SSCR as an innovation strategy. (Ebbutt, D. and Bentley, D., SSCR; in preparation)
- *A methodological account of the evaluation strategies of the review.* A report on methodologies for the evaluation of process and product. (Ebbutt, D., SSCR; in preparation)

Some off-the-shelf INSET programmes

A commissioned INSET programme will be tailor-made to meet the needs of a particular school or LEA. But an off-the-shelf package may be sufficiently close to your requirements to be worth looking at. A number of these, in the form of workshops, are available or are being prepared. Here are the titles (two additional examples are described in detail in Section 6):

- *Some ideas on learning in the area of science Education:* a workshop pack;
- *Cultural images in science education;*
- *Discussion as a learning approach in school science;*
- *Drama as a mode of learning in the science curriculum:* their potential for science lessons;
- *Reducing the content of the science syllabus:* a workshop.

Further publications relating to particular curriculum areas

- *Science and Technology Education: issues from a conference.* (SSCR 1986)
  This is a report of an SSCR Conference held in October 1984 which was attended by representatives of Review groups engaged in basic development work. The conference aimed to explore ways of implementing, in schools, the overall aims of the Review relating to science and technology.
- *Doing Problem Solving: a collection of ideas and approaches* (in preparation)
  This booklet explores a number of varied approaches and provides a wide range of practical classroom illustrations and activities.

SECTION SIX

Some workshops

A whole-school one-day workshop

Our experience has shown that there are occasions when identified needs or particular issues are important enough, if time is available, to warrant a whole-school workshop. The importance of the issue is one criterion for establishing such a workshop, the other is that the issue needs the widest possible airing and sufficient time for the whole school to tackle it collectively. This means that discussion and debate must be structured to allow *everyone to contribute* at some stage. This kind of issue is often one that has been identified as the result of a local authority or HMI inspection, or in response to a national curriculum report, e.g. The Bullock Report. We suggest that the workshop be structured in seven stages, at least five of which take place in one day.

1 **Pre-day planning:** 45–60 minute meeting prior to the workshop, with follow-up work such as collecting the materials for use as the workshop resource base.

2 **Session One**: 30 minutes.
3 **Session Two**: 45 minutes.

Coffee

4 **Session Three**: Plenary session: 60–90 minutes.

Lunch

5 **Session Four**: 60–90 minutes.

Tea

6 **Session Five**: Plenary session: 45 minutes.

7 **Post-workshop**: Days, weeks or months afterwards.

Box 20 *Programme for a whole-school orkshop*

Pre-day planning

1 At an early stage, **form a planning group** of perhaps four people. We would counsel that this group should not automatically be the top four in the school hierarchy. We suggest one representative from amongst the headteacher and deputies, one from the heads of departments, one from the year or pastoral heads and one young teacher. Ideally each representative should be elected by their respective peer group.

2 Consider questions of **venue** — the school itself is not always the most appropriate place. Consider using a nearby teachers' centre, a college or conference centre, which will free you from the telephone and other distractions.

3 Consider **who should attend.** The whole teaching staff must attend for the whole time, but you might also invite for part of the time:
local primary and/or tertiary colleagues;
school non-teaching staff;
parents;
governors;
LEA advisers/administrators;
young people from school.
One of the outsiders could be invited to evaluate the workshop, but make sure you ask someone who has the required experience.

4 Using staff lists **divide staff into mixed groups** for each session. You will require large groups of six to eight and small groups of three to four. Appoint one member of each group to act as an independent chairperson. This role could be shared within the group across the sessions. Publicise the groups with the suggestion that each large group consists of two small groups.

5 Decide on **pre-day reading** and **information** (domestic or otherwise) for each participant.

6 Arrange for a central **pool of resource material.** This could be supplied from the staff library, the school departments and responsibility areas, the local teachers' centre or a friendly institution of higher education.

7 Ensure that domestic arrangements and such **administration** as is necessary are organised well ahead of time.

Session One – Defining the theme and establishing an order of priorities for subordinate issues

People from outside the school will need a clear exposition of the context and the theme of the workshop. We suggest that this should be followed by an exercise that allows the raising of issues within the theme selected, with the minimum of discussion — at this stage. A useful method would be the Nominal Group Technique (NGT). This is an activity in which participants work in their large groups. For those unfamiliar with this particular technique it is simply a means

of drawing up a list of priorities from a group of participants as fairly as possible and with the minimum of debate and pressure. The object is to ensure that, as far as possible, both a process of democratic decision-making about issues takes place and that all present participate in it. (Full details of the NGT approach are to be found in the Workshop for Heads of Science Departments which follows.)

Session Two – Clarifying and articulating the goals

1 The NGT session will have identified a range of issues or problems associated with the theme of the workshop (one example might be an agreement that all staff adopt a common marking policy). The purpose of this session is to clarify and re-state the issues in terms of a school-specific problem.
2 Ask the groups to spend time **brainstorming** solutions to the problem/issue posed and pare these down to one or two workable solutions or 'actions to be taken'. You might, for example, phrase this as follows:

*In this session, working in your **small groups** you are asked:*
*In **one** sentence, to define the problem.*
In a second sentence, to state the group's favoured solution to it.
In a third sentence, state the group's criterion/a for establishing success in the solution of the problem.

3 Ensure that the debate is as wide as possible and that **a number of perspectives** are included: those of students, parents, employers, future needs...
4 Large groups re-assemble to hear reports on the problem area and possible solutions from the small groups. **Critical comments** are invited.

Session Three – Agreeing on the action to be taken

Work is again in the same large groups. The aim of this session is to build upon the previous one and to translate each problem into action, i.e. for implementation in the school. If the problems that have been identified are whole-school problems, you might think about pointers for action by staff, either as school policy or for direct implementation, i.e. on the use by all of a common marking system for correcting prose.
If some of the problems and potential solutions are particular to the science department, you might like to have **Better Science: Making it happen** (a companion publication to these Curriculum Guides) and also local working group and SSCR Central Team materials available as a resource bank. Whatever the problems and solutions **relevant resource material must be available.**

Session Four – Plenary session

This might contain the following strands:

- a report back from each small group in the form of, say, a poster session;
- an alternative is to have each group prepare an overhead transparency of their recommendations, this would be presented to the whole group by the course leader;
- a short pithy input from an outside evaluator who has been present for the whole of the day;
- a discussion of 'where next?' in the short, medium and long term;
- what happens about planning future INSET sessions and how every individual might be given access to the planning.

And afterwards?

You might consider the following:

- How might a mechanism be established which allows every individual participant the chance to comment upon the day and issues arising from it?
- What in-service needs for the staff collectively and for individuals, have been identified from the day?
- For the suggested solutions to become school policy the support of the headteacher and governors is essential. The political implications of new policy will need consideration, comment and agreement.
- What can be done to ensure that the proposed action/solutions are implemented and their effect monitored?

Final note

This sort of structure for a whole-school one-day workshop has been used successfully by a number of schools. Many people who worked on the Review during the development phase have some experience of tackling this kind of work and are often able to help and advise. It may be, for example, that either we or your LEA Advisers have contacts with other schools who have identified similar needs, and found solutions to their problems.

INSET courses for heads of science

1. Introduction
2. A suggested timetable for the first day of a course
3. Things for the tutor/organiser to do:
   - 3.1 before the day
   - 3.2 on the day
   - 3.3 afterwards
4. Notes on role play
5. A sketch — 'What Now 5–16?'
6. Running the NGT sessions and discussing the results
7. Organising and evaluating the small group

Box 21 *Contents of an INSET course for heads of science*

Introduction

Many science advisers, if not all of them, organise short courses or conferences for heads of science. Such courses can vary in length from a few hours to a week or more. They may or may not be residential. Usually all the participants work within the same local authority but this is not always the case. Several science advisers from the West Midlands, for example, organise a joint annual conference at Matlock for heads of department from their various LEAs. The recently inaugurated DES 4/84, 3/85 or 1/86 courses which bring together heads of science, or potential heads of science, for lengthier periods of time and with supply cover provided, offer even greater opportunities for appropriate in-service work. The organisers of these courses will have worked with a steering committee which includes science advisers, experienced teachers and lecturers in higher education amongst its members. They will not only be involved in the pre-course consultation but also in the post-course evaluation.

What do the heads of science, all experienced teachers, need and expect from such INSET courses? Before answering that question, there are a number of relevant observations that spring to mind. Firstly, the expectations (on the part of the HODs) of what a course might cover does not appear to vary a great deal. What does vary are their priorities and understanding of them. Perhaps the people best fitted to identify and articulate these needs are the individuals themselves. Secondly, there may be genuine and possibly urgent needs which an individual may have but may not recognise personally. Arguably the best, and certainly the most acceptable and least threatening, way of recognising such hidden needs is through discussion with a peer group. In Section 3 we suggested that one form a course such as this could take was for the organiser to set certain pre-course tasks which would provide a focus for the activities. Positive and fruitful discussion is enhanced when it is well informed and focused on commonly identified problems. It is in such a situation as this that pre-course planning and collection of data comes into its own.

Thirdly, the individuals within such a group provide an extremely diverse and effective resource base of expertise and ideas in themselves. So to return to our question: the most important thing that a heads of science course can do is to enable the participants to learn from each other. The work should therefore be interactive and the agenda ought to be negotiated by the participants, who understand, individually and collectively, what their needs are. The role of the tutor/organiser is that of facilitator. However, it may not be feasible to plan the course in this manner. Provided the steering committee is given real influence and choice, they should be able to plan and organise a suitable course.

Although it is the needs of the heads of department that should be our starting point these should be seen in the context of their schools, departments and the individual pupils within them. In other words, it is the *effectiveness* of the heads of department that we are aiming to enhance. Their personal comfort and sense of fulfilment, though obviously relevant, are not paramount. However hard a teacher works, however polished the performance, however efficient the management of time and resources, these are of no avail if they are not directed to achieving the aims of the institution and the more pressing needs of the individual pupils. We therefore suggest that one way to start such a course would be to identify the nature of the job of the heads of department. What should they be doing, and how, and why? What are the priorities?

Most heads of science are very busy people and we think that many of them try to do too much. How many of the things they do are not really necessary at all? How many of them could be done by other people? Are they working so intensively that they do not have time to pause to think about their role and do some self-appraisal? In their zeal to deal with immediate management and teaching tasks are they neglecting, unintentionally, more or equally important aspects of their job?

Before we take this consideration further we should look at the role of the tutors, facilitator or course organiser. We suggest that course participants should be encouraged to discuss the nature of their job, to define it. We do not think that the tutor should articulate the questions we

have listed in our previous paragraph. We believe that participants can and will do this themselves given a relaxed atmosphere, a sense of purpose and a supportive environment. It is the tutor's job to provide these and a good deal of thought should be given to them in the planning stage. Although the kind of open-ended approach we advocate makes the actual programme unpredictable, an experienced tutor should certainly speculate about how things might progress and be prepared for at least some eventualities. There are techniques available, some of which we describe below, for facilitating and organising discussions and for reporting back in a constructive way.

Resources will need assembling and organising. The tutor may arrange to have audio-visual and computer hardware available. Good domestic organisation, flexible timing, and available spare rooms can help to make an interactive and open-ended programme run smoothly.

There is a place for didactic input, from the tutor or from other experts, when, for example, it is requested by the participants as they recognise the need for information or an exposition of new skills. The approach to this aspect of the course need not conflict with the notion of interactive or negotiated planning. In an extended course such inputs are likely to be identified by the participants during the pre-course discussions and, provided the course as a whole is flexible and not overloaded, can be organised given sufficient notice. Above all, the tutor must provide appropriate stimuli for action and discussion, particularly at the beginning of a course.

We describe below how the first day of an interactive, participant negotiated course for heads of science may turn out. The tutor provides stimuli, resources and techniques and also, in turn, receives stimuli from participants which can provide guidelines for the rest of the course. This interactive process should, of course, not be confined to the first day but should continue throughout the course although the agenda will become clearer and more crystallised as time goes on. One of the things which it is hoped participants will learn from the process itself is how to operate confidently and calmly in just such an open-ended and creative situation in their own departments, with their colleagues and with their pupils.

A suggested timetable for the first day of a course

The purpose of the course is to allow heads of department the opportunity to consider mutual problems and seek through discussion, consultation and classroom research potential solutions. The tutors will use their previous experience of such courses in setting the pre-course tasks. In addition, the heads of department through discussions with their headteacher and department colleagues about the course programme, will bring with them some fairly well defined priorities from their school.

Session One A short sketch leading into role play.

Coffee

Session Two Four simultaneous 'Nominal Group Technique' (NGT) exercises.

Lunch (bar)

Session Three Plenary discussion session on outcomes of NGT exercises and an introduction to Session Four.

Tea

Session Four Small group discussions.

Task: To decide what issues should constitute the agenda for the major part of the course.

Box 22 First day sessions

The programme for the first day of the course is designed for acclimatisation; in other words, it functions rather like the traditional pre-course reading. Through their involvement in a number of interactive activities, course participants will be encouraged to raise and discuss openly important issues connected with their role as heads of science departments and will have the opportunity to construct the elements of an agenda for subsequent sessions.

We assume that there will be 20 to 30 participants. If there are more than this, it will be necessary to modify the proposals made and it would probably be wise to split the course into two parts for the initial role play. We will examine each of the sessions in turn.

Things for the tutor/organiser to do

Before the workshop

1 The course organisers should attempt to visit each of the participants' schools. The purpose of the visit is to discuss the nature and purpose of the course with the HOD and department members and with the headteacher. This should help to identify some of the priorities as seen by the individual school.

2 Pre-course tasks should be set for the participants well before the commencement of the course.

These will, of course, have partly been identified during the visit, and will partly arise from previous experience. It is very easy for important ideas to be missed and if this is the case it may be necessary at some stage to introduce them.

3 Participants should be listed in advance in conveniently sized groups; a group size of six to eight seems to us to be about right. A chairperson and a recorder will be needed for each group. It might be helpful to select these in advance if the course members are known. If you think it necessary, include a note on the role of the successful chairperson. These are seen as key people, and are likely to require 'briefing notes' in advance of the session. The timing and nature of these notes is problematic if the course plans are not finalised.

4 Notices of the meeting should be sent out in advance together with any pre-conference reading. It is important that the clientele read this, in advance, so a note to that effect should be considered. Include if necessary copies of the DES *Science 5—16: A statement of policy* (**1.2**).

5 Some teachers are reluctant to take part in role-play exercises so it is advised that the pre-conference papers should also include some general notes on role play and maybe even a brief for each individual although this is probably not necessary.

6 Pre-conference papers should also include outline programmes for the rest of the course. These should make quite clear how much is open to negotiation and what activities and events cannot be changed. There should be plenty of blank spaces! This is an important working document for the final discussion session.

7 The initial actors in the sketch should volunteer or be selected, briefed and provided with copies of the script. There is little point in selecting a course member who is very reluctant, for whatever reason, to take apart in the role play work.

8 Rooms must be booked, one for plenary sessions and, if possible, one for each working group. The main room should of course be large enough to accommodate all the participants and must be provided with an overhead projector. The afternoon discussion groups should be supplied with flipcharts and pens.

9 Arrangements for meals may also have to be made.

On the day

- Experience has shown that even if briefs are sent out in advance it is wise for the tutor, chairpersons, recorders, role players and any other support staff to meet together for a few minutes before the day starts. About fifteen minutes is needed. This is the best time to give chairpersons any resources and equipment they may need (e.g. acetate sheets and OHP pens).
- The tutor has to introduce the workshop by explaining its purpose, outlining the programme for the day, making necessary administrative announcements and giving any general guidance on working that is considered necessary.

Session One — The Role Play

It would be wise to circulate around the groups to check that they are doing either what they were asked, or volunteered to do. During group sessions the tutor can afford to relax provided pre-conference planning and organisation have been effective. It is wise to check that everybody has all the equipment they need, that meal arrangements are correct, etc. The tutor should ensure that chairpersons can find her/him quickly in case there are any queries. Further notes on role play follow later.

Session Two — The Nominal Group Technique session

At the end of the NGT session the transparencies prepared by each group must be collected in. The tutor will use them to lead discussion in the final plenary session. No other formal reporting should be called for; any ambiguities will be resolved and amplification made during discussion. An alternative technique is to use a poster session. This perhaps saves a bit of time because participants can study the posters during a refreshment break. On the other hand posters, in our experience, are not as immediately useful as OHP transparencies for stimulating discussion during a plenary session. More details on running the NGT session are given later if you need them. The purpose of the session is to identify the final list of issues prepared, in order of priority, by each group from which the agenda for the rest of the course will emerge.

Session Three — Plenary Session

The tutor has to chair the plenary session. This is essentially a time for explanations and the identification of group recommendations. Again more information follows later.

Session Four — Small Group Discussions

The tutor now has to introduce the final activity of the day — the group discussions which will lead to proposals for the remainder of the course.

At the end of the day the tutor has to collect from each chairperson/recorder their group's proposals for the rest of the course.

Afterwards

The tutor now has to evaluate the day's work and to plan the programme for the rest of the course. One should take into account the proposals made by the participants in the final session and should try to include them all and, of course, also be guided by the outcomes of the NGT sessions and on one percieves the needs of the participants and their school. There may already be some fixed points in the programme especially if outside speakers have already been booked or visits planned.

Notes on role play

Sustained role play demands very careful preparation. The brief is crucially important, you must be fully conversant with the situation or context within which you are operating, the basic beliefs and attitudes to be represented and the intuitive behaviour of the person being played. Not only must you be conversant with their personality but also how they reconcile themselves with the way in which they approach their job.

It is difficult to avoid stereotypes; it is essential to avoid caricatures at all costs. It is often helpful to imagine yourself to be a person you know quite well, someone you like and respect, perhaps admire. If you try to portray someone you dislike or despise you will not do them justice and that will make it easy for other people to dismiss their views.

There is a lot to be learned through role play. Some of us have experienced playing the same role before different audiences and observing how this influences the attitude of others. We have, for example, found how much more effective and constructive is a gentle, caring and co-operative attitude compared with an aggressive and overtly intolerant approach even where the role player is firmly pursuing, quite single mindedly, the same objectives. We have also found role play to be very enlightening about the attitudes and feelings of others. You really can experience how they think, feel and react, which must help to make you both a more tolerant person and a more successful manager. You can actually feel yourself getting angry about things which in real life you might think quite trivial. Indeed, one of the minor difficulties about role play is the problem of getting out of the role in order to explore it from the point of view of one's everyday self.

There are of course many differences between role playing and real life. When role playing you sometimes have to invent reality as you go along. If you are questioned about or have to react to an issue which was not mentioned in your brief, you will have to invent an attitude quickly to cope with the situation. This of course is one reason why it is important to explore the role thoroughly in advance and thus to internalise some of its intrinsic attitudes. You will probably be surprised how easy it is to do just that.

The tutor may decide to arrange a debriefing session with discussion group chairpersons and recorders to help with course planning.

A sketch: 'What Now 5–16?'

It would be advisable to allow the initial actors five minutes together to clarify their 'characters' to each other, prior to the commencement of the exercise.

The tutor will have to explain what is about to happen...

We have a short and incomplete script for Fred James and Roz Forsythe, two heads of science, and for Walter Smythe the Teachers' Centre warden. Four other colleagues are going to play probationary teachers. They have been given outline briefs about their roles but no script. We hope that the rest of you will join in the discussion; you have received some general notes on role playing. Please feel free to play a role or simply to be yourselves.

The scene is Daisy Street Teachers' Centre, 4.30 p.m. on a wet Thursday afternoon. Fred James (56), head of science at Downtown comprehensive is lolling in an old armchair distractedly flicking through Science 5–16: A Policy Document.

Enter Roz Forsythe, (early 30s), head of science at nearby Clearview Comprehensive.

Fred – *Hello Roz, I didn't expect to see you here this evening. I thought the meeting was only for the diehards.*

Roz – *No, well er yes, its for all heads of science – a chance to meet some probationers, I believe. Er actually I'm rather hoping you can loan me that document you are reading. You see I've got an OU assignment I intended to finish tonight and ...*

Fred – *Here have it. It's just the usual government verbiage.*

Roz – *How do you mean? My tutor thinks it is quite a clear and powerful statement as to what we should be considering.*

Fred – *Yes, well I suppose he ...*

Roz – *She ...*

Fred – *...yes, well let's face it, what does she know about real schools. It's just ivory tower nonsense.*

Roz – *But surely Mr. Jam..er Fred, taken in conjunction with the LEA policy statement on*

science education it's just possible to discern really interesting directions in which science education is moving. For instance what about the idea of 20% science in years 4 and 5? You know, Sir Keith's clutter bit, and double certification…

Fred – *Reduction of content! Who'll accept that? The exam boards? Parents? The government? Look, I trained as a physicist. What you're suggesting is that I've got to teach biology. I don't know any! What would happen if a kid asked me about photosynthesis? They'd think I was thick! I can't be expected to learn all those biological facts at my age, assuming I wanted to. Anyway, this 20% science is a non-starter. Two into three just will not go on the timetable.*

Roz – *I think that the policy gives us a chance to start from the bottom and build up. Anyhow, GCSE means that we will have to sort out those sorts of nuts and bolts problems pretty damn quick. It doesn't necessarily mean that you've got to teach biology. First of all there are ways of organising science that you might find interesting and, secondly, are you saying that you can't cope with some science that we expect 11 and 12 year olds to study?*

Fred – *You know I'm not saying that and you also know it's not as straightforward as you suggest. I need to do more than just cope. Anyway what are these 'ways of organising science' that you mentioned?*

Enter Walter Smythe, Teachers' Centre warden with four probationers, one from Downtown, one from Clearview and two from nearby Primary schools.

Walter – *Hi Roz, Fred, lovely to see you. I wonder if we could join you. I've got these four probationary science teachers (Makes introductions) on an induction course and my speaker hasn't turned up yet.*

Roz – *Yes do join us. We get so little opportunity to share and discuss some of the big issues. We're just talking about the DES Policy Document. We could examine problems about continuity from primary to secondary. Better still, I'd like to hear what's going on in primary science these days.*

Fred – *Talking of primary science I hear that one of our primary schools won an award for young engineers.*

Roz – *Well Fred, what are you going to do with those kids when they come to you next year?*

Walter – *This is great, shall I sort of act as chairman? As a non-scientist perhaps I can supply the broad view. Where shall we start?*

Fred – *You could open the bar!*

Roz – *Really, Fred! I've just heard today that we're having a general inspection soon and I've a fair idea what the HMIs will use as criteria to assess us. Why not start there?*

The script ends here but the discussion continues with the actors remaining in role. It is hoped that other participants will join in the discussion playing themselves or other people just as they see fit …

Subsequently the tutor may decide to review with the group its views as to the potential of such an exercise as a teaching tool with children.

Finally we would like to mention the liberating aspect of role play. It enables you to explore attitudes and approaches which you might not risk in reality. After all you can always deny them afterwards!

Running the NGT sessions and discussing the results

Nominal Group Technique (NGT) is the name given to a particular process which is intended to give everybody in the group an equal opportunity to express an opinion with no dominant personalities. The role of the chairperson is a *neutral* one.

We offer two alternative approaches to this session. The first relates to the earlier advice we offered. Here the participants would identify the issues in science education as they saw them and then place them in an order of priority. The alternative, which is under closer direction by the organiser, uses the session to tackle a different question which will give greater breadth to the ensuing plenary session. Here are some suitable suggested questions. (The tutor/organiser can use the pre-course visits to prepare the list.)

- In what respects do you regard yourself as a good head of department?
- What are the tasks that must be done by you as head of science?
- What do you see as the most significant changes that you have made, or would like to make, in your department?
- What issues have you already discussed, or feel the need to discuss, with other heads of department in your school?
- Where or what do you see as the greatest opposition to change in your school?
- What techniques are available to you as head of department to overcome the opposition to change?

The procedure for the first five stages of the session are set out in Box 23. They are followed by the plenary session. When the NGT work is complete the course organiser should collect in the OHP transparencies prepared by each group, ready for the plenary session.

At the *plenary session* the organiser displays each OHP transparency in turn, while outlining the findings of the group concerned. We have found

1 *Introduction*
The chairperson presents the group's task and explains the procedure.
2 *Individual preparation*
Group members *individually* prepare a list of up to six responses to the task and assign priorities to them.
3 *Round Robin*
Each member in turn reads out the priority currently at the top of their list. Everybody writes it down and numbers it. The readers now deletes it from their list. *No discussion or comment is allowed.* Repeat this, in sequence around the group, until suggestions are exhausted. During the process individuals may omit things from their list (usually because they have already been mentioned), modify, or add additional points.
4 *Clarification*
If people find any points on the list ambiguous now is the time to ask for clarification from the originator — but no discussion or value judgement is allowed.
5 *Voting*
Each member of the group has six votes to select the six points for the group to present at the plenary session. Somebody notes these on an acetate sheet.

Timing
Introduction 5 minutes
Individual preparation 10 minutes
Round Robin 15 minutes
Clarification (if necessary) 10 minutes
Voting 5 minutes

***Box 23** Procedure for the first five stages of an NGT session*

it more appropriate *not* to use a group member for this explanation but you are advised to invite a representative from each group to clarify their suggestions, should the need arise.

All participants are urged to note the main recommendations being made in view of the task ahead.

Encourage discussion at this stage especially where it helps to identify those issues thought to be most important in the eyes of the whole group.It is quite possible that this discussion will carry over into the tea break.

Organising and evaluating the small group discussions

The next task is to discuss the various suggestions from the groups with the intention of planning the course programme. There are a number of ways of approaching this and we offer one suggestion that has worked for us. It is likely that you have other ideas on how to handle a very loosely structured situation which may well be better.

Administratively it will probably be most convenient to keep to the same groups that did the NGT sessions earlier in the day. This is, however, a very different session and the tutor may feel that there should be different chairpersons, preferably people with previous experience of this sort of work. Good recorders, not necessary for the NGT, are also essential. Flip charts will be useful so that everybody in the group can see what is being written down.

Members of each group should be in no doubt about the importance of this session. They really are engaged in the negotiation of the rest of the course. No doubt they will take into account the points raised during the earlier sessions.

Draft outline programmes for the rest of the course should be available so that the participants know how much time is available and what firm arrangements have already been made. Chairpersons should not allow participants to get bogged down with detail. Selection of suitable speakers, simulation exercises and other exercises are the responsibility of the tutor/organiser although concrete suggestions will no doubt be welcome. The main purpose of this session is to identify from the proposals made and agreed upon earlier, what participants feel they need to get out of the rest of the course and this should be made quite clear.

It would be helpful if the recorder, perhaps with the help of the chairperson, could remain behind after the session is over to prepare the report. The tutor would be well advised to try to arrange a debriefing session with recorders and chairpersons as soon as possible. It would probably be best, however, to read their reports first.

Where now?

By the time this first day comes to an end, there will be a clear agenda for the remaining part of the course. There could be a break of several weeks between this session and the follow-up work or it could continue next day. The organiser will need to provide suitable back-up to allow the demands to be met. Visiting speakers, workshop leaders and other providers will need to be briefed as to the interactive nature of the course. Time must be provided for the participants to discuss and develop possible solutions to their curriculum problems and some form of report-back by the HODs should be planned. For example, each course member could make a presentation based on their priority, to the whole group, hopefully augmented by the members' headteachers and possibly their science adviser.

It should be expected that an evaluation of the implementation be carried out in the months following the course. This is not necessarily a task for the organiser, although they are likely to be involved in either advising on evaluation techniques and strategies or in suggesting suitable evaluators. These could be members of the group.

SECTION SEVEN

A final thought

A final thought

When the Review began its development phase in 1983 it invited science teachers and others in England, Wales and Northern Ireland to join together to map out the direction that secondary science education should take. Many teachers responded in a magnificent way to that call and it is by courtesy of their energy, ideas and sheer hard work that we have arrived in such good shape at the end. However, the journey is not over, as the dissemination phase looms close. What we have attempted to do in this guide is to provide teachers with some advice and ideas on how they can further develop and improve the science curriculum at school level. We hope that we can continue to support you in the next three years and in turn gain, through you, an opportunity to see many of the ideals glimpsed in this document brought to fruition. It will not be easy because we have not trod this path before, nevertheless the experiences of the last three years give us the confidence to forge ahead.

THANK YOU

APPENDIX I

A selection of typical tasks for heads of science courses

1 *Pre-course task*

Choose two pupils in your department of varying ability from the 2nd and 3rd year, whom you are not currently teaching.

For each pupil arrange to observe them for a double period (without their knowing that they are the focus of your attention). As soon afterwards as practicable have a brief discussion with them about their experience of the lesson. It may be necessary to remind them of the various phases of the lesson, and useful to organise the discussion around what they have written in their books. Then try to discover what the scientific concepts and ideas that formed the substance of the lesson's content mean to them. What is their understanding of them, and what do they see as significant?

N.B. The use of this kind of activity will be further discussed 'on course'. You are not expected to be experts yet!

2 *Current issues in science education*

During each week there will be a theme underpinning the sessions. This can act as a focus for some of the work concerned. For example the *theme* will be the primary–secondary school interface. The *task* will be to divide into self-selected groups of not more than four and produce a brief statement of the management issues which surround the primary–secondary interface and outline a possible plan for the scheduled primary school visit.

3 *Group member inputs*

School based assignments: evaluation phase. Two course members will give their reports on the school based tasks they selected, in consultation with their headteachers. The reports for this session are:

(a) Introduction of a 'Science for all' curriculum (13—16) in a high school. (Beverley S)

(b) Introduction of compulsory double science in years 4 and 5. (Peter C)

Remember that the presentation will be to the other course members, the headteachers of the participating schools and the respective science advisers. We have also invited a member of H.M. Inspectorate and some representatives of local industry and commerce.

4 *For the record*

It is intended that participants will be occupied this week in completing a written account of their work for publication in a booklet for use by fellow teachers and future course members.

The examples above have been synthesised from course materials provided by three centres, namely:

The University of Newcastle upon Tyne and Newcastle Polytechnic. (Our thanks are due to Mike Byrne and John Beattie.);

The University of Nottingham and Trent Polytechnic. (Our thanks to Richard Hull and Alan Jones.);

Brighton Polytechnic with The University of Sussex. (Our thanks to Michael Eraut.).

However, experience suggests that these examples are typical of many of the tasks set in other centres.

APPENDIX II

Information for PGCE students: timetables

Date	Core topic	Chemistry method	
20.09.85	Guided observation CC	Introduction to method course The school science curriculum : recent trends MSB/PC	
27.09.85	Lesson planning/peer group planning PC	Acids and bases : exploring the development of concepts;teaching approaches MSB	
04.10.85	GUIDED OBSERVATION IN SCHOOL		
11.10.85	Guided observation: discussion, safety MSB	Separating substances : introductory approaches to practical work PC	
18.10.85	Peer group teaching RS	Topics in chemistry : student demonstrations PC	
25.10.85	Assessment I : purposes and methods; group exercise MSB	Reactivity series : matching teaching approaches to pupil development MSB	
01.11.85	Assesment II : evaluation of methods; group exercise MSB	Examinations for pupils at 16+ PC/MSB	
08.11.85	SCHOOL EXPERIENCE PREPARATION		
	Teaching Practice – 4 weeks		
13.12.85	The full ability range RS	TP Discussion MSB/PC	
	End of Term		
10.01.86	Language and learning CC	Organisation of science dept/TVEI (visiting speaker) PC	
17.01.86	Language in science CC	Widening the range of teaching approaches : interactive learnig exercises MSB	
24.01.86	TEACHING PRACTICE PREPARATION		
	TEACHING PRACTICE		
21.03.86	End of Term		
18.04.86	Small group work in schools	CLISP — Summary : use of workshop MSB	
25.04.86		Student papers	Prep for small group work MSB/PC
02.05.86		Student papers	Prep for small group work MSB/PC
09.05.86		Student papers	Prep for small group work MSB/PC
16.05.86	Evaluation of work done in school/School & poly staff	Probationary year (visiting speaker) PC	
23.05.86	SSCR and related topics J Hornsby	Conceptually difficult areas in chemistry PC	
	Spring Bank Holiday		
06.06.86	Career and professional development MSB	Teaching the new sixth form PC	
13.06.86	Visit to Benfield School (novel learning strategies)	Learning theories and science teaching MSB	
20.06.86	Problem solving 5–16	The role of practical work: recent research MSB	
27.06.86	Visit to Cramlington High School (TVEI)	Applied and social aspects: implications for teaching/assessment PC/MSB	
04.07.86	Assessment of practical work MSB	Course review PC/MSB	

APPENDIX III

Information for PGCE students: planning and preparation

(The summary appended is only part of the advice offered on 'Lesson Planning' and 'Preparation'. Other sections include sample lesson plans, evaluation and recommended reading.)

Summary

This session is concerned with the fundamental tasks of teaching, namely *planning lessons* and *preparing the materials and strategies* whereby pupils' learning takes place.

The session will also provide activities which can be pursued in Method Groups, and recommendations for co-ordinating these activities with school experience.

Introduction

Classrooms can be bewilderingly complex places for the beginning teacher. Part of the reason for this is that so much is going on at any one time and there is always a chance that something unexpected will happen or as one researcher put it the most salient features of classroom environments is their 'multi-dimensionality, simultaneity and unpredictability' (Doyle, 1977). Thus in order to cope in such circumstances student teachers have to learn how to perform a variety of different roles, e.g., the distributor of resources, the assessor of pupil performance and the manager of classroom behaviour. In addition they have to learn how to deal with a number of things simultaneously, for example, whilst giving individual help to a pupil a teacher must remember to scan the rest of the class and to acknowledge other pupils who are requesting assistance. Of course it is more difficult to cope in some classrooms than in others but there is no doubt that your chances of 'survival' will be increased if you are well prepared and have a good lesson plan — especially if that includes the use of some interesting and stimulating resources and involves the pupils in activities which they see as being relevant and which motivate them to learn. Fortunately, there is no shortage of accumulated experience and plenty of guidance in the literature of most subjects on how you should go about the task of lesson planning and preparation.

It is likely that most of the sources you consult will advise you to start by defining your *aims and objectives* but we would like to suggest that there is an important preliminary stage to be gone through first.

In the literature this is sometimes referred to as *situational analysis*. Basically all that this means is that there are certain things which you need to find out *before* you can begin to plan your lesson. Given below are a few examples of the kind of thing we have in mind.

(a) Do you know the exact point in the scheme of work that the class will have reached before your lesson?
(b) Are you aware of the lessons which will follow yours in the sequence?
(c) Do you know what resources you will have at your disposal such as textbooks, filmstrips, equipment etc?
(d) Do you know how familiar the pupils are with certain ways of working such as group work?
(e) Do you know what the conventions and routines are that the pupils are expected to follow with regard to their written work?

This list is by no means exhaustive but we hope that we have said enough to convince you of the importance of *background information* of this kind as an essential pre-requisite to lesson planning.

Aims and Objectives

Once you are satisfied that you have sufficient information of this kind to hand you are in a position to begin the task of lesson planning proper. Whilst there has been a great deal of debate about the role of objectives in curriculum planning (see, e.g., Stenhouse, 1975) there is no doubt that student-teachers find it helpful to have a clear sense of purpose whenever they are confronted with a class. *Aims and objectives* are one way of stating these purposes. They differ from each other in their level of specificity — aims being more general and longer term, objectives being more specific and shorter term. When planning your lessons you might find it helpful to think about objectives in terms of the kinds of changes in the *behaviour* of your pupils that you are trying to bring about. For example, some or all of the following might have to be considered:

(a) the new *knowledge and understanding* you want them to acquire in the lesson;
(b) the *skills* you would like them to practise and develop;
(c) the *feelings* you would like to evoke in them or the *values* and attitudes you would like them to question or clarify.

In the literature (see, e.g., Bloom, 1956) this

threefold division of objectives into *cognitive, psychomotor and affective domains* is not uncommon. However, critics of this way of thinking about planning to teach in this way (see, e.g., Eisner, 1969) say that we should also have *expressive objectives* in mind especially if we teach subjects such as art, music, drama and literature (but expressive objectives are by no means restricted to them). What Eisner is doing is to remind us that in many situations in school we cannot pre-specify what the learning outcomes will be e.g. we do not know how an individual pupil will respond to an aesthetic experience such as reading a poem, viewing a landscape, listening to a piece of music or for that matter peering down a microscope or observing a chemical reaction.

One further point about objectives is that you should not allow your thinking to be dominated by the subject you are planning to teach. Of course you should have *subject specific objectives* but you should also have objectives for your lesson which are concerned with *general education goals* such as developing the pupils' ability to read and write effectively, behave responsibly and to co-operate with others.

Strategies

Once you have clarified in your own mind what it is that you are trying to teach you should be ready to take the next step which is to think about the question of *how* you can best achieve your aims and objectives. In other words you need to consider:

1. The *subject content* of the lesson and how best it can be organised and structured in relation to the age and ability of the pupils, the range of ability in the class and what they already know.
2. The *learning activities* in which the pupils will be engaged i.e. what they will be asked to do (including any alternative to cater for pupils of different abilities in the class or those with special educational needs). These may include things like performing a scientific experiment, drawing a map, doing a group improvisation in drama etc.
3. The *resources* you will need to transact the lesson including:
   (a) *teacher's resources* such as prepared OHP transparencies, slides, filmstrips, wall charts, laboratory equipment etc.
   (b) *pupils' resources* such as textbooks, worksheets, items of equipment etc.
4. The *arrangements* you will have to make to ensure that the resources you need are available when you need them e.g. the *booking of equipment* such as audio-visual aids.
5. The *sequence of events* within the lesson, the amount of *time* you plan to devote to them and planning for crucial *transitions* from one activity to another.
6. The *procedures* you plan to adopt in the lesson in relation to the effective *management of the class*, e.g. the way in which you intend to organise the room, how you will get the class into groups, the actions you plan to take over the pupils who may have difficulty in reading the worksheet, the steps you intend to take with regard to safety in the laboratory, etc.

Further reading

Further reading

The compiler of this list has attempted to identify books, articles or papers that were found to be particularly informative and/or useful in the areas covered by this guide; it is not intended to be comprehensive. Some of the titles will introduce teachers to the changing political thinking that lies behind many public pronouncements. Many of the publications listed under *References* come into the categories of this list and would repay further study. A general bibliography will be found in **Better Science: Key proposals** in this series.

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The Secondary Science Curriculum Review (SSCR) was set up in 1981 to stimulate, through working groups of practising teachers, the development of science studies which would help to provide an appropriate science education for *all* young people growing up in a scientific and technological society — whatever their abilities or career intentions. Its concern was not only with the science curriculum — its contents, purposes, teaching methods and resources — but also with the role of science in general education and within the whole school.

The **Better Science: Curriculum Guides** are based on the combined experience of the Review's Central Team and the working groups. Each Guide deals with a different but significant area of concern. Together they aim to assist teachers both in devising a broader and more balanced approach to science studies and in enhancing their professional development. The intention throughout is not necessarily to provide answers but rather to provoke and encourage teachers' thinking about the various topics addressed.

This Guide, **Better Science: Learning how to teach it,**

- shows that learning to teach better science
  - starts formally with initial training
  - continues through an induction period
  - is consolidated through a regular in-service programme;
- will enable teachers to operate successfully in the system.

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Better Science: Making it happen summarises, for a wide audience, the thinking of the Review and provides a guide to implementing balanced science for all pupils.

Heinemann Educational Books/Association for Science Education for the School Curriculum Development Committee

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Better Science: Making it relevant to young people 3
Better Science: Approaches to teaching and learning 4
Better Science: How to plan and manage the curriculum 5
Better Science: For both girls and boys 6
Better Science: Working for a multicultural society 7
Better Science: For young people with special educational needs 8
Better Science: Health and science education 9
Better Science: Building primary–secondary links 10
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